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ENVIRONMENTAL PROGRAMMATIC STATEMENT

for INTENSIVE LIVESTOCK MANAGEMENT on NATIONAL RESOURCE LANDS

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Bureau of Land Management
I, March 1973

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Preliminary Review Draft
March 15, 1973

SUMMARY

(X) Draft ( ) Final Environmental Statement

Department of the Interior, Bureau of Land Management

1. Type of Action: (X) Administrative ( ) Legislative

2. Brief description of proposal:

   To manage livestock use on the national resource lands under principles of multiple use, sustained yield of renewable resources and environmental protection and enhancement. The basis for the programmatic statement is that grazing animals are an integral part of the range ecosystem.

3. Summary of environmental impact and adverse environmental effects: Changes in vegetative cover and removal of energy from the site in the form of livestock production; effect on soil erosion; effect on water pollution; effect on quality of wildlife and fish populations and habitat; and effect on esthetic values.

4. Alternatives considered:

   (1) Custodial supervision of livestock grazing.

   (2) Removal of all domestic livestock from national resource lands.

   (3) Moratorium on livestock grazing until funds are available to initiate intensive management.

   (4) Disposal of all National resource lands.

5. Comments have been requested from the following:

   (See attached list on next page.)

6. Date draft statement made available to CEQ and public: (To be provided).

Preliminary Review Draft Submitted to the Following:

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INTRODUCTION

The environmental statement for livestock grazing management has been prepared in accordance with the National Environmental Policy Act of 1969. This programmatic statement relates to the livestock grazing program administered by the Bureau of Land Management and analyzes the environmental impact of intensive livestock management proposed for the National Resource Lands, formerly known as the Public Domain Lands or Public Lands.

OBJECTIVE

This statement will provide a broad analysis of intensive livestock grazing management and its impact on the environment.

It will also serve as the foundation and framework for subsequent environmental analysis and statements which may be required for range management activity programs. It will identify factors needing close attention in such analysis as well as areas needing further study for definitive information prior to decision making on proposed actions. Parts of the statement may also be extracted for inclusion in environmental impact statements for a particular range management action on specific areas of land when judged to be applicable.

SCOPE

The action described in this environmental statement is directed at intensive livestock grazing management, through Allotment Management Plans (AMPs) which utilize a grazing system prescribing a rotational

grazing use sequence designed to provide for improved range condition and sustained yield of the vegetative resource.

The statement does not attempt to cover all components of the range management program or to analyze in detail environmental impacts of actions which may be taken to implement intensive grazing management systems. Specific actions such as land treatment practices or range conversion projects are treated in separate environmental impact statements. The livestock grazing statement is more significantly concerned with the ecological impact of intensive management on the national resource lands taking into account that certain physical projects will be necessary to implement that management.

In considering alternatives to intensive management, a multitude of degrees of management could be discussed. However, the basic alternatives are no management or removal of livestock. The four alternatives covered in the statement refer to these basic issues.

ASSUMPTIONS

Many practices associated with intensive livestock grazing management are not presently being carried out on the national resource lands because of land use planning and budgetary constraints. However, the statement will not distinguish between the present and potential program. It is assumed that the possibility for expanded or universal application of intensive management practices does exist.

1. Background & History

BACKGROUND AND HISTORY

Grazing animals are a natural part of the rangeland environment in the United States. Before the European settlers arrived, a virgin rangeland occupying over 850 million acres extended from the Mississippi to the Pacific and from Canada to Mexico. Wildlife was abundant and included large herds of herbivores, some of which are now considered rare or endangered, and others that are now extinct. Bison, deer, elk, and antelope exerted a great influence on natural rangelands. They are not confined by fences and other man-made facilities and were able to migrate to and from seasonal ranges in a natural grazing rotation which permitted periodic rest for the vegetation from effects of grazing, allowing time for natural growth processes. By the 19th Century, however, advent of large scale cattle operations, beginning with the trail herds from Texas to the Midwest, established an impact on the range ecosystem that was to increase significantly in subsequent years. The buildup of sheep operations which occurred simultaneously with the cattle boom also began taking its toll of the range resource. Thus, natural ecosystems of the Western United States have developed under pressure of hoofed herbivores which were a natural component of these ecosystems.

During the 19th and 20th Centuries as human populations increased and settlements expended westward, disrupting natural range ecosystems, numbers of domestic livestock increased. Wildlife populations were often-times deliberately decimated to reduce their competition with sheep and cattle.

The reduction of the bison population is the outstanding example of man's influence as he moved westward. Also thousands of feral horses that had arrived on the scene nearly 200 years earlier by way of the Spanish Conquistadors in Mexico, added to the impact on the dwindling supply of available grazing land. Rangeland that once supported incredible numbers of large herbivores as well as smaller wildlife species underwent some drastic changes in vegetative composition because of the grazing habits and confinement of domestic livestock. In addition, millions of acres were converted to farmland, thereby significantly reducing the size of the rangeland ecosystem.

As a result of overgrazing and other activities of man (farming, burning, logging, etc.), ecosystems that had been previously subject to little geologic erosion began losing valuable topsoil.

Drastically accelerated erosion occurred on the more fragile areas. By 1900, productive capacity of the entire area that comprises what is known today as the National Resource Lands -- nearly 180 million acres in the Western United States -- was becoming drastically reduced. Gradually there was a growing public and Congressional awareness that this significant natural resource needed protection and management.

During most of this period, agriculture and mining were the most important segments of the economies of the Western States. Generally, these states were sparsely populated and most of the towns which

existed were trade centers for agricultural areas or mining communities. Trade centers existed primarily for the agricultural interests and agriculture was also very important to the mining towns as a source of food.

Early beginnings of agricultural development were primarily for local and home consumption. As railroads expanded into the Western United States, markets were developed for beef, sheep, and other resource production from this region. As a result, demand for range resource products increased. Cattle and sheep were transported to heavily populated areas in the East and in California. With ready markets for their products, cattlemen and sheepmen utilized the Western rangelands to their fullest.

Concern for orderly use of the national resource lands became manifested when migrant sheep outfits moved their sheep from range to range in direct competition with local sheep and cattle ranchers. The cattlemen, through homesteads and other land and water base acquisitions had established operations within designated geographic areas and attempted to exert control of the Federal land through registration of water rights, herding laws and the like. (Clawson, 1971).

There was insufficient range area and inadequate forage to sustain the livestock industry that had developed and which was competing watered more lands suitable for agricultural areas or grazing opportunities. Early records indicate generally, for the agricultural interests and agriculture was also very important to the grazing lands as a source of feed.

Early beginnings of agricultural development were primarily for local and home consumption. As settlements expanded into the western United States markets were developed for beef, sheep, and other livestock production from this region. As a result, demand for range resources suddenly increased. Cattle and sheep were transported to western rangeland areas on the hoof and by railroads. With ready markets for their products, cattlemen and sheepmen utilized the Western rangelands to their fullest.

Consequently, one of the earliest resource lands became management when [illegible] sheep [illegible] from areas on range in direct competition with local sheep and cattle ranchers. The conflicts [illegible] for given land and range being appropriated and established [illegible] within designated grazing areas and attempts to [illegible] control of the limited land and range resources of water sources, holding them and [illegible] [illegible]. 2
[illegible].

There are [illegible] many sites and incidents [illegible] [illegible] the [illegible] [illegible] [illegible] and also which was [illegible] for the depleted grazing capacity. Unfortunately, this realization was not readily accepted. Many ranchers considered the range forage inexhaustible. Little was known about livestock grazing management as it pertained to sustained yield of the rangeland ecosystem.

Public rangeland conditions became critical and finally, in 1934, landmark legislation known as the Taylor Grazing Act was enacted by Congress. The purpose of this Act was to stop injury to the public grazing lands by overgrazing and soil deterioration; to provide for their orderly use, improvement, and development; and to stabilize the livestock industry dependent upon the public range (Preamble to the Taylor Grazing Act, 1934).

The Act authorized the Secretary of the Interior to establish grazing districts and to issue permits to graze livestock in these grazing districts to bonafide settlers, residents, and other stock owners upon the payment of reasonable annual fees. On vacant and unreserved public lands outside established grazing districts, the Secretary was authorized to issue grazing leases with preference given to homesteaders, and owners or occupants of contiguous lands.

To implement the Taylor Grazing Act, a Division of Grazing was established within the Department of the Interior in 1934. A few years later it was renamed the Grazing Service. Regulations were promulgated which became known as the Federal Range Code.

Qualifications for grazing livestock on the Federal range have not changed since enactment of the legislation. An applicant must be engaged in the livestock business and must be a citizen of the United States. In addition, if the applicant is a group, association or corporation, it must be authorized to conduct business under the laws of the State in which grazing privileges are utilized.

Initial apportionment of grazing privileges was based on the relative dependence of the applicant upon Federal range, including forage and water. Preference in granting of grazing privileges was given to those applicants within or near a district who owned land or water. Extent of grazing privileges issued was based generally on the use made by the applicant during the five years prior to passage of The Taylor Grazing Act. There was little attempt during this initial allocation of privileges to adjust grazing use to the carrying capacity of the range. The initial thrust of the Grazing Service program was to allot available Federal range in accordance with recognized grazing qualifications. Considering many conflicting claims of prior use, designation of allotment boundaries was in itself a monumental task without attempting to question and verify qualifications for numbers of livestock and seasons of use. In addition, assignment of numbers and use areas was complicated because widespread drought and depression had already caused significant reductions in livestock numbers.

With a total Grazing Service complement of 47 field personnel to handle hundreds of applications in each district, as well as applications for grazing leases on public lands outside district boundaries, the Service was understaffed from its inception. As a result, management that was applied during the beginning of this era could best be described as custodial. With a meager $150,000 annual budget to administer the Federal range during the early years of the Grazing Service, the District Advisory Boards that were organized pursuant to the Act provided valuable assistance to Grazing Service personnel in determination of qualifications, allocation of grazing privileges, setting seasons of use, and other matters affecting grazing administration.

In 1946, the Grazing Service was combined with the General Land Office to form the Bureau of Land Management (BLM). Just prior to establishment of BLM, Congress drastically reduced operating funds to the Grazing Service. During this critical period many District Advisory Boards contributed their own resources to keep the Grazing Service offices in operation. However, increasing awareness of resource management needs as a result of studies revealing the extent of poor range conditions led to increasing emphasis for better management. By 1950, appropriations had increased sufficiently to allow BLM to hire additional professional range conservationists and intensify the range management program. This signaled the start of a phaseout of the custodial period as the BLM, with a larger and better-trained

work force, began to refine the process of apportioning grazing privileges begun by early administrators and Advisory Boards.

This new program thrust, or range adjudication as it was called, consisted of several actions. Primarily an inventory of the range forage resource was conducted to determine a proper number of animals that could graze the area, and to provide a record of vegetation and its ecological status. It included a vegetation type map, grazing preference palatability tables of various plant species, and data on physical characteristics of the land such as topography, character of the soil, and suitability of the area for livestock grazing. From this data and the map, a range manager could obtain information that would aid him in making decisions concerning the desirability of use for livestock grazing and need for range development work. Periodic rechecking and updating of data was also used to evaluate range condition trends and other ecological changes.

Based on these studies, ranchers were allocated certain areas, with a given number of animals, during a given season. Often these decisions conflicted with the ranchers' historic range use and required a reduction in livestock use. The range adjudication process often resulted in extended legal proceedings that greatly slowed progress. Controversy and competition between range users highlighted this period.

Adjudication did not proceed at a constant pace throughout the Bureau and in some areas the process was repeated several times. As a result of this and limited financing, the process dragged on for over 15 years. However, by 1965, the bulk of range adjudications was completed and the Bureau's management capability was redirected toward implementation of intensive livestock grazing management.

In addition to efforts by the Grazing Service and Bureau of Land Management during this period, the Forest Service, Soil Conservation Service, Extension Service, and Agricultural Experiment Stations at land grant institutions in the Western United States intensified programs to educate and do research regarding proper range management. The era of conservation which had its beginnings during the first 30 years of the 20th Century came into full bloom after the passage of the Taylor Grazing Act.

This is not to say that the Taylor Grazing Act cured all the ills created by poor management and overgrazing experienced prior to its passage. But, it stemmed the tide of unrestricted grazing and allowed for improvements to be made. During the period 1930-1970, both physical and economic research was conducted regarding range improvement practices under intensive management. Range scientists found out what could be done to improve the ability of the range resource to provide feed for livestock and economists determined the economic feasibility of such measures. It became apparent that some range improvements were physically impractical in some areas (Gray, administration did not progress at a constant pace throughout the decade due to many causes, not the least of which was personnel ceilings. As a result of this and limited financing, the program dragged on for over 20 years. However, by 1965, the bulk of range adjudications was completed and the Bureau's management capability was redirected toward implementation of intensive livestock grazing management.

In addition to efforts by the Grazing Service and Bureau of Land Management during this period, the Forest Service, Soil Conservation Service, Extension Service, and Agricultural Experiment Stations all made great contributions in the Western United States agricultural programs in research and in research regarding public range management. The era of conservation which had its beginnings during the first 30 years of the 20th Century came into full bloom after the passage of the Taylor Grazing Act.

This is not to say that the Taylor Grazing Act cured all the ills created by past management and overgrazing experienced prior to its passage. What it created was rule of law, organized planning and a need for improvements to be made. During the period 1950-1970, both physical and economic research was conducted regarding range improvement practices and range-livestock management. Range scientists tried and what could be done to improve the ability of the range resource to produce more for livestock and wildlife, determined the economic feasibility of such practices. In a few specific cases some range improvements were physically impractical to make using (Cook, Stubblefield, Roberts, 1965.). Others were economically unsound for private ranchers to attempt without Federal aid. The Federal Government decided that range improvement practices were in the public interest and allowed the Agricultural Stabilization and Conservation Service to share costs with private ranchers for range improvement practices. For the most part, range improvements did make good economic sense to the rancher and the public interest.

Although the Taylor Grazing Act, by the very nature of its title, gives the impression that it relates only to grazing, it is the basic legislative authority governing management and protection of national resource lands in the Western United States. Provisions of the Alaska Grazing Act and the O&C Act provide for livestock and reindeer grazing on approximately 275 million acres in Alaska and two million acres in Western Oregon. The proposal set forth in this Statement for intensive grazing management is intended to apply to those areas as well.

CURRENT SITUATION

Except for small, highly specialized areas, grazing by domestic livestock has consistently been a major economic use for large areas of the West. For decades, ranchers have used both public and private lands in their operations, but over the long run the number of animals grazing public ranges has decreased (Roberts, 1963). Table 1 depicts amount of grazing in grazing districts and Section 15 lands administered by the Bureau of Land Management. It may be noted

Table 1: Amount of Grazing in Grazing Districts (Section 3) and Section 15 Lands, 11 Western States, 1935-1970

Calendar year	Amount of grazing in districts 1/ (Section 3)			
	Cattle and horses	Sheep and goats	Section 15	Total
	(1000 AUMs) 3/			
1935	NA 2/	NA	NA	6,507
1940	NA	NA	NA	13,832
1945	NA	NA	NA	15,572
1950 4/	9,205	5,256	NA	14,461
1955 4/	10,186	5,181	NA	15,367
1960	8,738	3,716	1,688	14,142
1965	8,830	2,943	1,905	13,678
1970	8,626	2,354	2,659	13,639

1/ Includes free use, crossing, and trailing permits in addition to regular paid use. Effective calendar year 1960 exchange of use permits included.

2/ Not available.

3/ One animal unit month represents the forage required to maintain five sheep or goats, or one horse or cow for a month.

4/ Fiscal Year.

Sources: Report to the Director of BLM or Public Land Statistics.

that animal unit months (AUMs) of grazing reached a peak during World War II and have decreased somewhat since then.

Table 2 shows the Federal and Bureau of Land Management land areas and the percent of the total land areas for the 11 Western States. The percentages of Federal land areas range from 29.5 percent for Washington to 86.9 percent for Nevada with an average percentage of 47.7 percent for all 11 states. Bureau of Land Management percentages of land area range from 6.6 percent in Washington to 68.9 percent in Nevada and an average percent of 23.2. Although this does not give a complete perspective of the livestock production dependence for forage on Federal and BLM lands, it does give an idea of the significance of the national resource lands in contributing to rural economies through livestock grazing.

Public and private lands in the West are related in two general ways. First, both are integral parts of firms, of which livestock ranches are the dominant type. Second, economic development by a firm on public or private lands influences the use and value of lands of opposite ownership located nearby, even though these may not be part of the firm. The livestock economy in the 11 Western States is predominately a range economy. The degree of dependency on range forage varies by area. Table 3 presents information for the 11 Western States which attempts to illustrate the degree of dependence. For example, Nevada's cattle sales make up 66 percent

Table 2: Total Land Area, Federal Land Area, Bureau of Land Management Land Area by States and Percent, 1970

State	Total State Land Area (1,000 ac.)	Total Federally Owned Land (All Agencies Combined)		Bureau of Land Management Administered Lands	
		1,000 Acres	Percent of State	1,000 Acres	Percent of State
Arizona	72,688.0	32,336.6	44.5	12,602.1	17.3
California	100,206.7	44,903.8	44.8	15,584.9	15.6
Colorado	66,485.8	23,777.2	35.8	8,387.2	12.6
Idaho	52,933.1	33,797.1	63.8	12,095.1	22.8
Montana	93,271.0	27,630.0	29.6	8,154.4	8.7
Nevada	70,264.3	61,049.5	86.9	48,389.6	68.9
New Mexico	77,766.4	26,401.6	33.9	13,214.6	17.0
Oregon	61,598.7	32,209.3	52.3	15,697.5	25.5
Utah	52,697.0	35,022.0	66.5	22,741.7	43.2
Washington	42,693.8	12,600.4	29.5	292.0	0.6
Wyoming	62,343.0	30,102.4	48.3	17,423.8	27.9
11 Western States Total	752,947.8	359,465.0	47.7	174,582.9	23.2
U. S. Total	2,271,343.4	761,300.9	33.5	471,765.6	20.8

Source: Public Land Statistics, 1971

Table 3
Page 15

Table 3: Income, Employment, Agricultural Sales, Cattle Sales Total and BLM Cattle and Sheep AUM's and Selected Percentages, 11 Western States, 1970

State	Total Personal Income (millions dollars)	Total Employment	Agricultural Employment	Total Agricultural Sales (millions dollars)	Cattle Sales (millions dollars)	Cattle Sales as % of Total Agricultural Sales (percent)	Total Cattle AUM's (1000)	Sec. 3 Cattle BLM AUM's (1000)	Total Sheep (1000)	Sec. 3 Sheep BLM AUM's (1000)	Sec. 15 AUM's Cattle & Sheep (1000)	BLM % of Total AUM's
Arizona	5,213	614,055	24,605	611.2	306.4	50.1	14,187.7	579.2	1,261.3	14.0	271.1	5.6
California	72,466	7,484,690	233,857	3,902.9	861.8	22.1	43,532.3	162.7	4,137.0	36.9	165.9	.8
Colorado	6,883	825,779	38,093	1,100.7	742.5	67.5	34,827.4	428.1	3,494.0	195.7	66.1	1.8
Idaho	1,940	257,451	33,406	649.6	238.7	36.7	18,769.0	928.6	2,074.6	258.7	56.5	6.0
Montana	1,883	244,584	32,726	573.4	321.1	56.0	34,632.1	1,110.5	2,519.5	119.3	205.0	3.9
Nevada	1,618	197,809	4,786	80.9	53.5	66.1	6,778.1	1,740.4	500.1	357.9	35.7	29.3
New Mexico	2,488	322,837	15,352	358.8	233.7	65.1	17,532.2,	1,384.4	1,728.4	247.6	241.5	9.7
Oregon	6,616	778,754	42,465	531.2	144.4	27.2	14,881.9	865.4	1,281.2	14.6	143.0	6.3
Utah	2,865	378,562	14,360	213.0	74.1	34.8	7,733.5	638.1	2,434.2	533.7	-	11.5
Washington	11,491	1,233,063	54,769	771.2	168.9	21.9	11,432.4	*	312.6	*	*-	0
Wyoming	966	123,389	12,286	248.8	161.4	64.9	17,003.9	789.1	4,672.4	575.6	513.4	8.8
Totals	114,429	12,460,973	506,705	9,041.7	3,306.5	36.6	221.310.5	8,626.5	24,415.3	2,354.0	1,698.2	5.2

*The Washington BLM AUM estimates are combined with those from Oregon

Source: BLM Socio-Economic Data System

of total agricultural sales and the grazing lands administered by the BLM provide 29.3 percent of total livestock forage needs. The degree of dependency is, therefore, considered to be quite high in Nevada. Most of the other Western States depend upon BLM forage for livestock at a percentage rate of 5.6 percent or higher with the exception of California and Washington. Overall, for the 11 Western States, cattle sales represent 36.6 percent of total agricultural sales and BLM contributes 5.2 percent of total livestock forage needs.

ALPHABETICAL LISTING OF REFERENCES
for
BACKGROUND AND HISTORY

Clawson, Marion. 1971. The Bureau of Land Managment. Praeger Publishers, Inc., New York, Washington, and London. 209 pp.

Gray, James R., Thomas M. Stubblefield, and N. Keith Roberts. 1965. Economic Aspects of Range Improvements in the Southwest. New Mexico Agr. Exp. Sta. Bulletin 498.

Roberts, N. Keith. 1963. "Managing Private Lands in Relation to the Changing Uses of Public Lands." In Land and Water Use, Amer. Assoc. for the Advancement of Science Publication No. 73., Washington, D. C.

Taylor Grazing Act of June 28, 1934, (48 Stat. 1269) as amended and supplemented.

2. Description of Proposal

I. DESCRIPTION OF THE PROPOSAL

The proposal is to manage livestock use of national resource lands under the principles of multiple use, sustained yield of renewable resources, and environmental protection and enhancement. The basis for the proposal is that grazing animals are an integral part of the range ecosystem.

Authorities to carry out the program include:

a. Taylor Grazing Act. The Act of June 28, 1934 (48 Stat. 1269); 48 U.S. Code 315, as amended).

b. Alaska Grazing Act. The Act of March 4, 1927 (44 Stat. 1452; 48 U.S. Code 471, 471a-o), and the Act of September 1, 1937 (50 Stat. 902; 48 U.S. Code 250K).

c. O&C Act of 1937 (50 Stat. 874; 43 U.S. Code 1181).

d. National Environmental Policy Act. The Act of 1969, Public Law 91-100, January 1, 1970 (83 Stat. 852).

e. Soil Conservation and Domestic Allotment Act (Act of April 27, 1935, as amended; 16 U.S. Code 590a - 590q-1 (1964 and Supp. IV 1965 - 1968)).

f. Bankhead-Jones Farm Tenant Act (Act of July 22, 1937, 7 U.S. Code 1010-13a (1964)).

In compliance with laws identified above and supporting policy directives of the Department of the Interior and guidelines set forth by the Council on Environmental Quality, the overall objective of the Bureau of Land Management in grazing administration is to provide for environmental and improvement needs of rangeland

resources through the application of intensive livestock management practices. This is structured to improve or maintain range ecosystems by utilizing livestock as a management tool to manipulate vegetation in achieving desired ecological objectives.

As a resource management agency, the Bureau has attempted to adopt intensive management practices to reverse a century-old trend of declining range condition by redirecting the range management program to a more intensive level, utilizing the concept of allotment management plans (AMPs). This embraces principles of rest-rotation grazing systems and other management systems oriented to maintain and improve range conditions for multiple uses and at the same time stabilize the livestock industry as set forth in the Taylor Grazing Act.

The AMP program was initiated in 1964. Since that time 964 AMPs have been initiated on 23.4 million acres of national resource lands and 5.4 million acres of other intermingled state and private lands. Over this relatively short period of time the results have been encouraging; however, much remains to be done. The status of the AMP program is outlined in the following table:

Total plans required on national resource lands	8,230
Plans initiated through 1972	964
Estimated plans through 1973	1,084
Plans remaining beginning 1974	7,146
Total BLM acres (excluding Alaska)	170,000,000
Livestock grazable acres	140,000,000
Estimated acres needing AMPs	133,000,000
Estimated acres with AMPs through 1973	24,000,000
Acres remaining at beginning of 1974 needing AMPs	109,000,000

In addition to being an important source of forage for domestic livestock, the national resource lands have provided, and are capable of continuing to provide, an important source of forage and habitat for big game and other wildlife. By legislative decree, these lands are also managed for watershed protection, open space, timber, recreation and all other resource values including wild horses and burros.

The principle of multiple use contemplates that all uses and potential uses of resources will be provided for to the extent they are compatible with each other. This means that grazing by domestic livestock, subject to provisions of authorizing laws, will be considered in planning the use of national resource lands.

Sustained yield of renewable resources encompasses the principle that authorized uses will be managed in a manner that will keep the basic resource (soil) intact and productive, and maintain the capability of producing these resources on a nondepletion basis.

The principle of environmental protection and enhancement contemplates that ecological balances will be maintained, or restored and maintained, and adverse impacts on all environmental values kept to a minimum. Techniques and procedures incorporated in the intensive livestock management proposal to realize these three principles include the following:

1. Development of Resource Management Plans.

Resource management plans are developed by application of the Bureau's planning system. This system provides for dividing the national resource lands into logical administrative planning units and all existing and potential uses of the lands are listed and compared with each other. Within each planning unit an inventory (Unit Resource Analysis - URA) is conducted which describes the existing situation including data on climate, soils, vegetative types, hydrology, geology, topography, wildlife, timber, recreation, economic and social uses, and any other values for which management efforts might be required. Condition and trend of the land and resources are analyzed and opportunities for improvement and development are determined. Following this, a Management Framework

Plan is developed. This is a plan setting forth management parameters for a specific area which identifies the amount of various resource uses that are permissable in the area after consideration of basic laws, regulations and policy, facts about resources and their uses, public views, the determination of an optimum mix of multiple resource uses, and other inputs to the decision-making process. In addition, it describes the constraints necessary to insure compatability of uses, protection and enhancement of the environment and other objectives of management. The Bureau planning system provides for extensive public participation and hearings which help to identify resource and resource user conflicts, problems, and projected public needs. Public participation is encouraged in the determination of resource management goals to yield the greatest long-term sustained public benefits. Activity recommendations (such as those for range management, wildlife habitat management, etc.) as they relate to management of the various resources, are documented and proposed objectives listed for detailed action plans. After application of guidance of law, regulations, policy, and consultation with the public, a Management Framework Plan (MFP) describing permitted uses with any imposed constraints is adopted.

2. Development of Environmental Provisions and Safeguards.

Concurrent with, and as part of resource use planning, environmental analyses of potential or proposed actions are

recorded in order that decisions reflect and protect environmental values. If the analysis determines that a significant impact will result from the proposed action, an environmental impact statement for that action is prepared.

3. Development of an Activity Plan for Livestock Management

When livestock grazing is identified as a legitimate use in the Management Framework Plan (MFP) an Allotment Management Plan (AMP) is prepared to establish a system of livestock management consistent with other resource uses and objectives.

The AMP is the activity plan for livestock grazing management and is prepared cooperatively with the livestock operator(s). The grazing area or allotment is subdivided into management pastures and a grazing rotation or sequence developed to provide for normal life processes of plant growth and reproduction.

An example of a typical AMP is shown in Illustration I, pages 1 and 2. The basic components of an AMP are as follows:

a. General Information outlines basic resource information pertinent to grazing management, resource values and condition, vegetative types and grazing capacity, authorized uses, existing facilities and other livestock management considerations. Resource problems such as soil erosion, critical wildlife habitat, etc., are recognized.

b. Objectives. The determination of this component is guided by decisions adopted in the MFP. A statement of specific management goals and objectives to be achieved through proper control and management of livestock, such as watershed protection and rehabilitation, wildlife habitat protection and enhancement, wild and free-roaming horses and burro protection or other resource values are identified.

c. Grazing Management System. This is the "how" component of the AMP. It provides for manipulation of livestock among pastures based upon developmental stages of plant growth to provide for periods of rest for plant vigor and reproduction, production of seed and planting of seed by action of livestock during the grazing period. The system includes some or all of the following:

(1) Pastures which are open and closed to livestock grazing for designated periods as dictated by plant growth requirements and needed rest.

(2) Livestock management facilities to be constructed (e.g., fences, water developments, etc.).

(3) Land treatment projects to be made (e.g., seeding, brush control, contour furrowing, etc.). These are kept to a minimum and used only to expedite needed resource improvements that cannot be accomplished exclusively by livestock management within a reasonable time frame.

d. The agreement section which identifies the management responsibilities of the livestock operator and the Bureau.

e. A system of data collection for monitoring the effects of the management effort to determine if the identified management objectives are being achieved.

A central principle of the livestock management proposal and subsequent Allotment Managment Planning is based on meeting physiological requirements of plants and using the grazing animal to assist natural ecological processes to improve other resource values such as protective vegetative cover for watershed management, wildlife habitat, aesthetic landscape, etc.

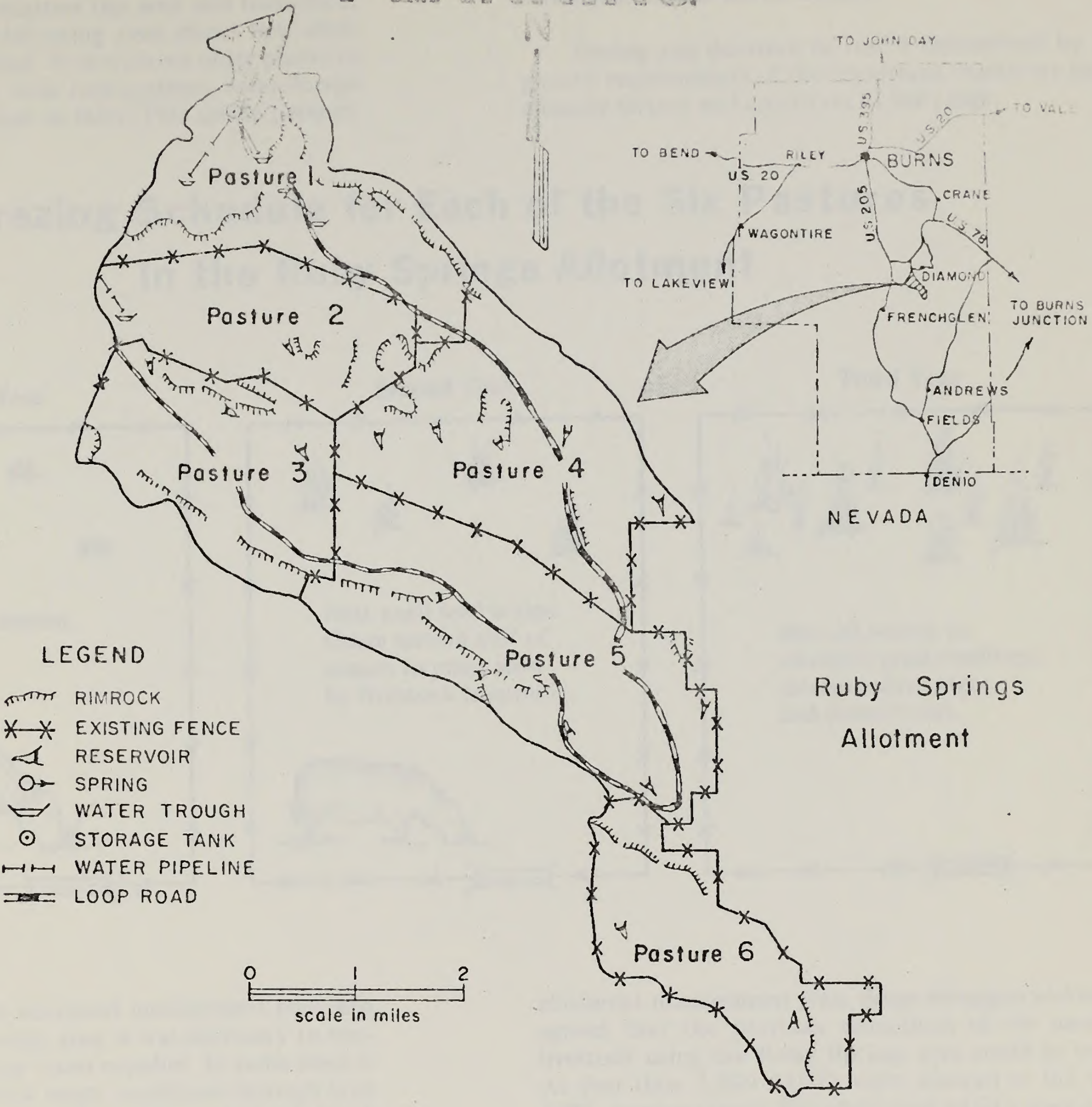
Livestock grazing is only one of many socio-economic uses that are expected or requested of national resource lands. It is recognized that the key management component of a range ecosystem is vegetation. Plants, through the photosynthetic process in the green leaves, are the only form of life with the capability to manufacture their own food. They grow for only a short period each year during which time, in addition to providing energy for growth, they must store sufficient food reserve in the form of carbohydrates to carry on the metabolic process and remain alive throughout the remaining period of the year. Continuous removal of the photosynthetic tissue ultimately kills the plant and periodic rest is necessary for plants to regain their vigor and produce seed. Only plants

can dictate the duration, amount, and frequency of grazing they can tolerate and still maintain a healthy condition.

Domestic livestock grazing has been and can continue to be an important use of rangeland administered by BLM. When properly managed, livestock grazing does not seriously conflict or interfere with the other multiple uses.

Because of the utility in using livestock as a vehicle to enhance other resource values, it is believed that the Bureau can best meet its multiple use responsibilities of managing national resource lands by continuing a program to intensify proper management of livestock. Accordingly, and in keeping with the Bureau's resource management program, it is proposed that emphasis be continued on intensive grazing management systems. It has been, and is proposed to be continued, Bureau policy to eventually implement cooperative AMPs and related grazing systems on all grazable national rangelands.

ALLOTMENT MANAGEMENT PLANNING



Managed Use For Enriched Resources

An Allotment Management Plan (AMP) is a program designed to improve vegetation by manipulating grazing animals. It is a cooperative plan developed by the Bureau of Land Management and the range user.

Through proper manipulation of grazing animals, desirable plants for livestock forage, wildlife habitat and the watershed are improved and maintained.

The first step in developing an AMP is to gather basic data and analyze the land area. The analysis must consider the effects vegetation changes will have upon the forage and habitat requirements of individual wildlife species as well as the effects these changes will have upon livestock production, soil protection, water quality, and natural beauty. Resource user demands, social, economic and other available information must also be considered.

After a complete analysis, the specific objectives or goals to be accomplished in the allotment are determined. An appropriate objective might be to improve bitterbrush for mule deer in a particular area.

A grazing system is then developed to accomplish the objectives. Most grazing systems incorporate sufficient rest from livestock grazing to give important plants the opportunity to increase in vigor. This produces additional forage volume and allows the plant to produce seed. Grazing is scheduled to trample the seed into the ground and follow-up rest is provided for seedling establishment.

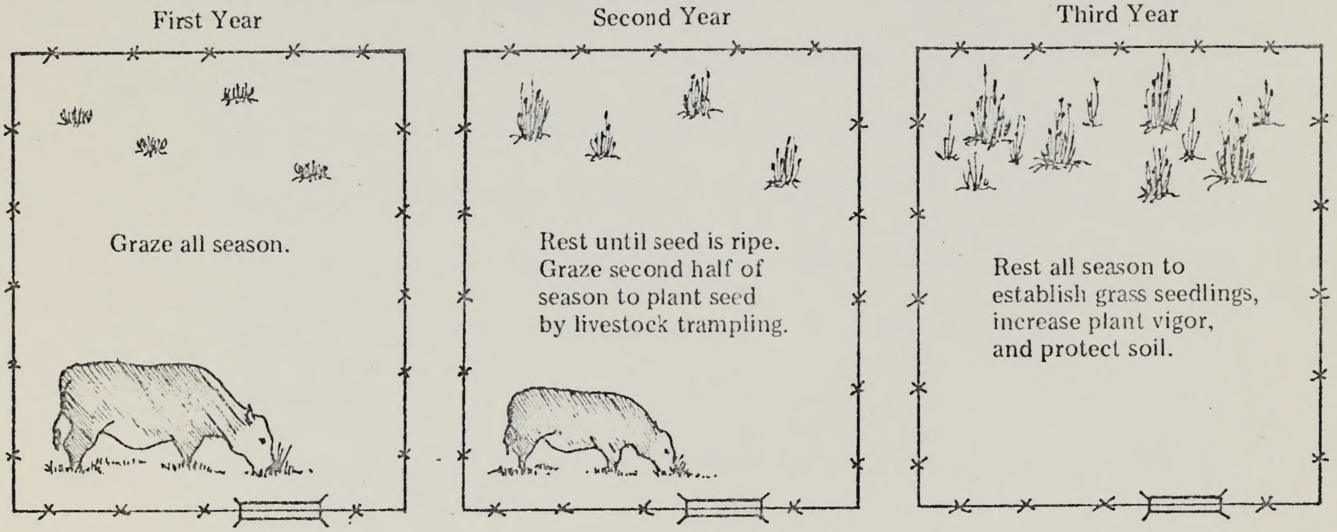
Continuous studies, evaluations and necessary adjustments are made throughout the life of the plan to ensure the objectives are accomplished.

Ruby Springs Allotment:

The Ruby Springs Allotment is divided into six pastures. Each year two are grazed season long, two are grazed after seed is ripe, and two are rested. Livestock use at the correct time shatters the seed and tramples it into the soil. Rest the following year allows new seedlings to become established. It also allows older plants to regain vigor and rebuild their root systems. Some forage remains on the soil surface as litter. This aids in protecting the soil from erosion. By providing ample grass for cattle, they do not use browse plants as heavily as they normally would. The forage on the pastures being rested is available for the use of wildlife.

Timing and duration of rest is determined by plant growth requirements of the important vegetation species, climatic factors and condition of the range.

Grazing Schedule for Each of the Six Pastures in the Ruby Springs Allotment


First Year
Graze all season.
Second Year
Rest until seed is ripe. Graze second half of season to plant seed by livestock trampling.
Third Year
Rest all season to establish grass seedlings, increase plant vigor, and protect soil.

Benefits:

In order to put the allotment management plan into effect in the Ruby Springs area, it was necessary to construct fences and develop water supplies. In some areas it was necessary to improve range conditions through land treatment. These practices included control of brush that was crowding out existing grass and seeding areas to crested wheatgrass.

In 1960, it was necessary to limit grazing to less than half of what it had been earlier in order to protect the range from severe deterioration and erosion. In 1965, after land treatment work and five years under the allotment management plan, range managers and ranchers agreed that the previous reductions in the number of livestock using the Ruby Springs area could be restored. At that time 2,360 AUM's were allowed in the area. In 1971, approximately 800 additional AUM's were allowed.

In addition, to increasing use by domestic livestock, the maintenance of vigorous vegetation and evenly distributed supplies of clean water proved beneficial to wildlife. Streams have been kept free of excessive sediment. This has improved public recreational opportunities.

Wildlife:

Mule deer are present in the Ruby Springs Allotment year-round; however, major use is during the winter months when snow forces additional animals down from higher elevations.

To maintain a healthy deer herd, it is important that sufficient forage and suitable habitat be provided. This is done through the allotment management plan. Vegetative species which provide forage and habitat are identified and their growth requirements determined.

When appropriate, livestock grazing use is controlled to obtain the proper growth of browse species and produce maximum usable forage for deer. Grazing adjustments are made as needed to reduce competition between mule deer and livestock.

Watershed Protection:

Soils must be protected if they are to maintain productivity and continue to produce renewable resources. A good cover of perennial vegetation protects and stabilizes the soil and reduces erosion. This results in a more constant and dependable supply of high quality water.

An increase in the number and vigor of high quality perennial plant seedlings is evidence that range conditions are improving and the soil will be protected from erosive forces.

In general, ground cover which provides highest quality forage for livestock and wildlife also provides best protection for the soil.

3. Description of the
Environment

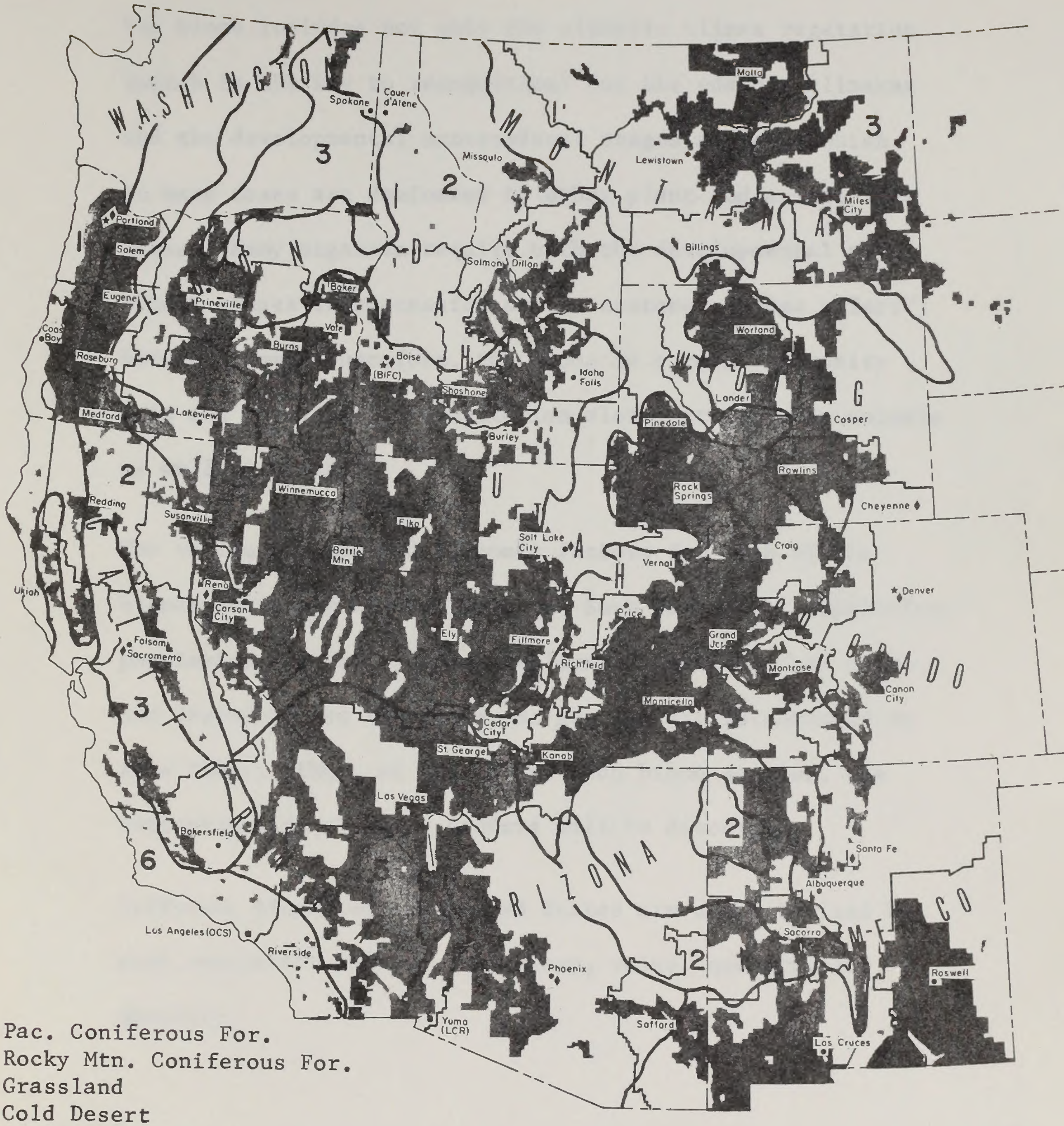
II. DESCRIPTION OF THE ENVIRONMENT

A. Introduction

Livestock grazing, as well as grazing by other herbivores, is a universal use in varying intensities, of the vegetative resources of all six major biomes described herein. Because biomes differ significantly in their physical structure, ecological importance, and socio-economic values, environmental influences of domestic livestock grazing will vary significantly among biomes. It is therefore logical to describe each of the major biomes where domestic livestock grazing on national resource lands is, and has been, a major resource use.

B. Description of the Major Terrestrial Communities, the Biomes, (Figure 1)

Regional climates interact with regional biota and substrata to produce large, easily recognizable community units called biomes. In a given biome, the life form of the climatic climax vegetation is uniform. Thus, the climax vegetation of the grassland biome is grass, although the species of dominant grasses may vary in different parts of the biome. Since the life form of the vegetation, on one hand, reflects the major features of climate and, on the other, determines the structural nature of the habitat for animals, it provides a sound basis for a natural ecological classification.



1. Pac. Coniferous For.
2. Rocky Mtn. Coniferous For.
3. Grassland
4. Cold Desert
5. Hot Desert
6. Woodland-Bushland (Oak-Chaparral)

▬ NATIONAL RESOURCE LANDS MANAGED BY BL

FIGURE 1

The biome includes not only the climatic climax vegetation (which is the key to recognition) but the edaphic climaxes and the developmental successional stages as well, which in many cases are dominated by other plant and animal life forms. Many organism require both the developmental and climax stages in succession or the ecotones ("edge effect") between them. Therefore, the biome is a total community unit and not a unit of vegetation alone; it includes animals as well as plants.

The various social and economic factors for each of the biomes are estimated in Table 4. Such factors as population, population density, income, employment, agricultural sales and dependence on BLM lands for grazing are illustrated in this table. Then, at the end of each biome section, the interpretation of these factors will be discussed.

Different biomes of the United States are characterized by much vegetative and animal variety, value, quality, and quantity.

TABLE 4

Socio-Economic Characteristics of the FIVE MAJOR BIOMES
of the 11 Western States
1970

Biome	Total Population	Total Acres	BLM Acres	BLM % of Total	Persons per Sq. Mi.	Total personal income (Mi.Dol.)	Total Employment
1 1/	1,018,664	11,848,320	439,992	3.71	55.02	3,495	351,476
2	2,889,686	102,408,560	8,869,800	8.66	18.06	8,817	1,050,143
3	9,404,239	208,819,840	27,021,512	12.94	28.82	32,226	3,495,652
4	2,804,625	240,450,560	96,974,841	40.33	7.46	7,471	487,986
5	14,306,961	124,155,520	34,207,452	27.55	73.75	51,063	5,350,824
Totals	30,424,175	687,682,800	167,513,237	24.359	28.31	103.072	10,736,081

Biome	Agric. Employment	Total Ag.Sales ($1000)	Cattle Sales ($1000)	Cattle Sales as % of Tot.Ag. Sales	Total Sheep & Cattle AUMs	Total BLM AUMs	Total AUMs
1	18,439	307,066	29,809	9.7	4,308,929	12,323	0.28
2	60,603	705,133	161,240	22.86	26,243,633	1,221,329	4.65
3	159,175	3,436,788	1,467,447	42.69	101,919,927	3,731,448	3.66
4	68,251	1,284,141	571,342	44.49	58,585,421	7,151,665	12.86
5	141,194	2,422,959	786,563	32.46	33,341,445	1,156,951	3.4
Totals	447,662	8,156,087	3,016,401	36,98	224,399,355	13,273,716	5.915

1/ Biomes are as follows:

1. Pacific Coast Coniferous Forest Biome
2. Rocky Mountain Coniferous Forest Biome
3. Grassland Biome
4. Cold Desert Biome
5. Hot Desert Biome
6. Woodland Brushland Biome

1. Grassland Biome.

As mapped in Figure 1, this biome consists of four distinctive, widely separated sub-regions:

a. Northern temperate grasslands extending from the eastern deciduous forest across the Mississippi Valley to the foothills of the Rocky Mountains including the Great Plains;

b. Southern temperate grasslands, including southwestern Texas and southern New Mexico;

c. Palouse prairie grassland occupying small portions of eastern Washington, northern Idaho, and north-central Oregon;

d. California prairie grassland occupying the Central Valley of California.

Lands administered by BLM in this biome are quite fragmented and are the residue remaining from the homesteading area. Historically, much of the land passed into private ownership because of the highly productive soils. In more recent times, irrigation has become a common practice. Approximately 30 percent of the land surface is in public ownership, administered by BLM, but about 70-80 percent of the mineral estate remains in Federal ownership. Even though BLM-administered lands are a relatively small part of the total and are fragmented, they are among the most productive lands under BLM's administration from the standpoint of range forage and quality wildlife habitat.

Topography

Topography of the temperate grasslands is predominantly rolling hills and plains. In general, the land slopes gently from West to East, ranging in altitude from 4,000-5,000 feet on the western boundary to 400-500 feet on the East. There are numerous isolated mountain groups such as the Black Hills in South Dakota and the Bearpaw, Little Rockies, and Big Snowy Mountains in Montana. Other unique significant areas include the Sand Hills of Nebraska, Badlands of South Dakota, and the glaciated regions of northern Montana and North Dakota.

The California Prairie (also called the San Joaquin Valley) is approximately 400 miles long and 50 miles wide. It is essentially flat with little relief between the river bottoms and the low hills and uplands on the edge of the valley.

Topography of the Palouse Prairie is essentially open hills and mountains, irregular plains, and moderate-to-high relief tablelands.

Climate

Climatic conditions within the Grassland Biome differs significantly because of the widely separated location of each specific grassland area within the United States. Therefore, each area is discussed separately.

Topography

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The California Prairie (also called the San Joaquin Valley) is approximately 400 miles long and 50 miles wide. It is essentially flat with little relief between the river bottoms and the low hills and uplands on the edge of the valley.

Topography of the Palouse Prairie is essentially open hills and undulating, irregular slopes, and moderate-to-high relief tablelands.

Climate

Climatic conditions within the grassland biome differ significantly because of the widely separated location of each specific grassland area within the United States. Therefore, each area is discussed separately.

The Northern Temperate Grassland has an average annual precipitation varying from 15 inches in the northwest to 30 inches in the southwest. Precipitation occurs primarily as rainfall from summer thunderstorms. Extended periods of drought are common. Temperatures range from -45°F to 100° F with mean daily temperatures of 0° F in January to 70° F in July in the north; and 50° F in January to 80° F in July in the south. Winds average 10 mph from the north in winter but are more moderate from the south in summer, laden with moisture from the Gulf.

The Southern Temperate Grassland is influenced by the continental air mass to the north and the humid Gulf in the south. Average annual precipitation, occurring mostly as summer thunderstorms, varies from 10 inches to 40 inches north to southeast. Temperatures range from -10° to 110° F with mean daily temperatures of 35° F in January to 75° F in July in the northwest; and 60° F in January to 80° F in July in the southeast. Winds are generally variable and light and during the summer blow generally from the southeast bringing moist warm air from the Gulf. Long periods of drought are not unusual.

The Palouse Prairie is influenced by the continental air mass, modified by proximity to the Pacific Ocean. Average annual precipitation, falling mostly during the winter months, is from 10 to 15 inches. Temperature extremes are -30° to 110° F with mean daily temperatures of 25° to 30° F in January and 70° F in July. Winds blow generally from the south, averaging 8 mph. Dust storms may occur during the dry summer months.

The California Prairie is greatly influenced by the Pacific Ocean to the west. Average annual precipitation varies from 6 inches in the south to 23 inches in the central portion, most occurring during the winter months. Winters are mild and summers are hot and dry. Temperatures range 15° to 115° F with mean daily ranges of 40° F in January and 80° F in July.

Vegetation

Grasslands cover very large areas and are extremely important from man's viewpoint. Grasslands provide natural pastures for grazing animals and the principal agricultural food plants have evolved by artificial selection from grasses. Grazing animals are the most feasible and economic means of harvesting this renewable resource. Man's record in using grasslands as pastures is not good, primarily because of insufficient knowledge and understanding of the requirements for growth and reproduction of grass. Many early civilizations developed in grassland regions in conjunction with domesticated grazing animals, but probably no biome type has been modified and abused to a greater degree by man. Even today, the great mass of people fail to understand that natural pastures must be treated with the same careful husbandry as cultivated lands, and thousands of acres continue to be converted into degraded sites by over-exploitation.

Grasslands occur where rainfall is too low to support the forest life form but is higher than that which results in desert life forms.

Generally, this means between 10 and 30 inches depending on temperature and seasonal distribution. Grasslands also occur in regions of forest climate where edaphic factors (such as a high water table or fire) favor grass in competition with woody plants.

In North America, the grassland biome is divided into east-west zones, i.e., tall grass, mixed grass, short grass, and bunch grass prairies, much of which has been replaced by grain agriculture, cultivated pastures, or have been invaded by woody vegetation because of grazing mismanagement and cessation of natural fires.

The growth form of roots is important. Roots of most species penetrate deeply and the fibrous nature of the roots serves to bind the soil against erosive action. Some species have underground rhizomes and are thus sod-formers while others are bunchgrasses and grow in clumps. These two life forms are found throughout the biome but bunch grasses predominate in the drier regions where grassland grades into desert.

The geographical origin of grass species is of special ecological importance. Species of northern genera grow primarily during early spring and autumn, becoming semi-dormant in hot weather (cool-season grasses). Warm season species of southern genera begin growth in the spring and grow continuously during the summer if moisture is available (warm-season grasses). From the standpoint of annual

productivity of the whole ecosystem over a period of years, a mixture of cool- and warm-season grasses is desirable. Replacement of such adapted mixtures by "monocultures" is bound to create oscillations in productivity.

Forbs (composites, legumes, and other broad-leaf herbaceous plants) generally comprise but a small part of the producer biomass in climax grasslands but are consistently present and may provide a vital nutritional need for consumer species. Increased grazing or drought, or both, tends to increase the percentage of forbs which are also prominent in early successional stages.

Within the Grassland Biome are marshes, lakes, ponds, and other water courses which support various forms of aquatic vegetation. Considering the fresh-water environment as a whole, algae are the most important producers, although other submergent vegetation and emergent higher type aquatic plants are prevalent.

The grassland is a vast solar-powered ecosystem, highly productive, and capable of storing great quantities of energy. Turnover of the biomass occurs quite rapidly on an annual basis resulting in rapid nutrient cycling. Soil organisms are numerous. As much as half of the ecosystem producer biomass is directly decomposed by fungi and bacteria rather than by herbivores.

productivity of the whole ecosystem over a period of years, a mixture of exotic and warm-season grasses is desirable. Continued mass of such mingled stands by "bunchgrasses" is bound to create restrictions in productivity.

Forbs (composites, legumes, and other broad-leaf herbaceous plants) generally comprise but a small part of the producer element in either grasslands but are consistently present and may provide a vital nutritional need for certain animals. Increased grazing or drought, or both, tends to increase the percentage of forbs which are also prominent in early successional stages.

Within the grassland biome are marshes, lakes, ponds, and other water courses which support various forms of aquatic vegetation. Considering the freshwater environment as a whole, algae are the most important producers although other submergent vegetation and emergent higher type aquatic plants are prevalent.

The grassland is a vast solar-powered ecosystem, biomass producer, and capable of storing great quantities of energy. Turnover of the biomass occurs under cultivation on annual basis resulting in rapid nutrient cycling. Soil organisms are numerous. Almost half of the vegetation produced biomass is directly decomposed by bacteria rather than by herbivores.

Except in locations of steep topography, low precipitation, and unstable soil, the grassland ecosystem is generally stable. Condition of the vegetation on national resource lands is fair to good with trend generally improving in recent years. Natural successional development occurs rapidly. The grasslands are most vulnerable to damage by grazing during drought.

Inadequate livestock management in the temperate grasslands has resulted in brush invasion (mesquite, sagebrush, creosote bush) in varying degrees.

Extensive areas in the Palouse Prairie have been invaded by annual grasses and sagebrush as a result of fire and unmanaged livestock use.

Perennial grasses of the California Prairie have been largely destroyed by unmanaged grazing and fire and have been replaced by annual grasses introduced from the Mediterranean region. The tule marshes along the major drainages of this area have largely been converted to ride production.

Soils

Soils of the grasslands are as diverse as the geologic provinces, their underlying parent materials, and events which shaped their eventual development. Generally, these soils are deep, fertile, well-developed, productive, and high in organic matter.

Except in locations of steep topography, low productivity, and shallow soil, the grassland vegetation is generally stable. Condition of the vegetation on national resource lands is fair to good with areas generally improving in recent years. General recreational development occurs rapidly. The grasslands are most vulnerable to damage by grazing during drought.

Inadequate livestock management in the Gallup grasslands has resulted in brush invasion (mesquite, snakeweed, creosote-bush) in varying degrees.

Extensive areas in the Columbia Plateau have been invaded by annual grasses and broadleaves as a result of fire and unmanaged livestock use.

Perennial grasses of the California Prairie have been largely destroyed by uncontrolled grazing and fire and have been replaced by annual grasses introduced from the Mediterranean region. The tule marshes along the major drainages of this area have largely been converted to crop production.

Soils

Soils of the grasslands are as diverse as the geologic provinces, their underlying parent materials, and climate which shaped their soil development. Generally these soils are deep, fertile, well-developed, productive, and able to absorb water.

In northern Montana and North Dakota soils are cool-moist organic-rich Mollisols. Further south, they are warm-dry Entisols. In Wyoming and Colorado are found warm-dry Aridisols and warm-dry organic-rich Mollisols. Eastern New Mexico has immature Entisols, Mollisols, Alfisols, and Aridisols.

Valley soils of the California Prairie include sediments eroded from surrounding mountains during Pleistocene and recent times and are classified as warm-dry soils. Alfisols are found above the stream valleys and Entisols along the rivers and streams.

Palouse Prairie soils are classified as warm-dry and are predominantly Mollisols or organic soils.

Soil Organisms. Small forms of animal life which spend their entire lives in the soil (as earthworms) or depend upon it for a part of the life cycle (as many insects) play a vital role in soil building. They also are extremely important items in the food-chain of larger animals. Micro-organisms are essential for soil building processes of organic decay. Members of the soil fauna comprise major components in the detritus food web, and hence they play very significant roles, either directly or indirectly, in the pattern and dynamics of energy flow and biogeochemical cycling of grasslands.

These soils are highly erosive by both wind and water when the protective surface vegetation is removed. Some critical areas, such as soils derived from bearpaw shale, are extremely erosive and require careful management and use. Although sheet and rill erosion are common when the surface vegetation is depleted, massive head-cutting is the dominant erosion feature.

Wildlife

A large proportion of animals of the grassland are either running or burrowing types and aggregation into colonies or herds is characteristic. Important large herbivores native to the grassland biome are bison and pronghorn antelope. Under natural conditions such large herbivores are highly migratory, moving from one area into another seasonally, or in response to food availability or predator pressure. High densities of animals can exist because of migratory behavior and because the diversity of species results in a balanced use of all species and seral stages in the vegetation. When such animals are "fenced in" or when they are replaced by sedentary domestic cattle, severe overgrazing often results. Through the ages man has been exceedingly slow to recognize the need for rotation of pastures. Perhaps the "elk problem" in our national parks is an example of our failure to recognize adapted behavior patterns and the necessity of replacing them with compensating human management procedures when such behavior is restricted.

Burrowing rodents, such as ground squirrels, prairie dogs, and gophers are important. Where man has reduced the population of rodent predators, such as coyotes, kit foxes, and badgers, a "rodent epidemic" often results; likewise rodents increase when the grassland is overgrazed by cattle or other grazing animals. In addition, if all grazing is removed, resultant accumulation of litter is conducive to increasing the rodent population.

Characteristic birds of the grassland biome include prairie chickens, meadowlarks, longspurs, horned larks, and rodent-eating hawks.

The large grazing mammals, whether native or domesticated, are as important as basic soil and climate conditions in determining vegetative composition since some species of grasses are more sensitive to grazing pressure than others. The term "decreasers" is used for palatable species sensitive to grazing and their disappearance is an early indicator of grazing stress.

Wildlife-Terrestrial. Most conspicuous in this group are the various mammals and birds. In the extensive Northern Temperate Grassland, characteristic animals include: antelope, white-tailed and black-tailed jackrabbits (in the north and south, respectively), prairie dog, ground squirrel, coyote, badger, ferret, pocket gopher, various waterfowl, prairie chicken, sage grouse, Swainsons hawk, rough-legged and ferruginous hawks, burrowing owl, many ground-nesting birds such as the meadowlark and horned lark, bullsnake, rattlesnake, grasshoppers, crickets and an abundance of other insects.

Burrowing rodents, such as ground squirrels, prairie dogs, and gophers are important. Where man has reduced the population of rodent predators, such as coyotes, kit foxes, and badgers, a "rodent outbreak" (more correctly, "irruption") may occur when the grassland is overgrazed by cattle or other grazing animals. In addition, if all grazing is removed, resultant accumulation of litter is conducive to increasing the rodent population.

Characteristic birds of the grassland biome include prairie chickens, meadowlarks, longspurs, horned larks, and grasshopper-eating hawks.

The large grazing mammals, whether native or domesticated, are as important as basic soil and climatic conditions in determining vegetation composition since some species of grasses are more sensitive to grazing pressure than others. The term "decreaser" is used for palatable species sensitive to grazing and their disappearance is an early indicator of grazing stress.

Wildlife—Grassland. Most conspicuous in this group are the grazing mammals and birds. In the Intermontane Plateaus Province ("Tonalite,"[illegible] characteristic animals include: antelope, mule deer, white-tailed and black-tailed jackrabbits (in the north and south, respectively), prairie dog, ground squirrel, coyote, badger, ferrets, kit fox, swift fox, prairie chicken, sage grouse, burrowing owl, rough-legged and ferruginous hawks, burrowing owl, many ground-nesting birds such as the meadowlark and horned lark, bullsnake, rattlesnake, grasshoppers, crickets and an abundance of other insects.

The Southern Temperate Grassland includes many of the same animals found to the north although some are a different species or subspecies. Additional forms, more common in the south, include the antelope jackrabbit, desert cottontail, collared peccary, scaled quail, white-winged dove, mockingbird, kingsnake, and numerous kinds of lizards.

On the Palouse Prairie, the sharp-tailed grouse was formerly abundant. The short-eared owl, burrowing owl and marsh hawk nest in the grassland. Cottontail and pygmy rabbit, pocket gopher, and golden-mantled ground squirrel, and various grasshoppers are characteristically present.

On the California Prairie, the California ground squirrel is one of the most characteristic species. This is also an important wintering area for waterfowl. Many of the same animals, perhaps of different subspecies, occur here as in other grassland areas.

Some grassland species will require special consideration within their ranges. For example, a local population may require a specific site at a particular season to continue its life cycle, such as strutting grounds for sharptail, sage grouse, or prairie chickens; and potholes, reservoirs, or marshes by waterfowl and shore birds for nesting and rearing young. Other species extend their distribution into subtypes and local populations become totally dependent upon such restricted habitat, as for example, the moose in eastern

Wyoming occupying wooded drainages within the grassland. Somewhat comparable are remnant populations of a species which, while not endangered throughout its range, is locally threatened with extirpation; for example, the sharptail grouse in the Palouse grassland. Another situation is where an entire local population is restricted to a site of its own selection (for reasons that may not be understood), such as prairie dog towns. Other species perhaps even less numerous are dependent upon the prairie dog or its habitat.

Wildlife - Aquatic. This group includes fish and various invertebrates confined to a water environment (as are shellfish). This brief treatment will concentrate on fishes. Aquatic fauna of this area as a whole are less diversified than in more humid regions. Throughout the vast Plains region there is not a single localized freshwater mollusk -- thus reflecting the widespread and general character of the habitats. Aquatic animals, like terrestrial ones, have specific habitat requirements which vary with the species. The natural distribution of non-migratory fish is confined to bodies of water having accessible and suitable spawning areas.

Warm-water species occur in larger streams and warm standing waters. Examples of these include the shovelnose and lake sturgeons, paddlefish, and gars of the Missouri River. Channel catfish inhabit small tributaries of the Missouri and some large reservoirs having relatively warm, muddy waters. Bullheads are adapted to a wide range

of conditions but prefer streams or ponds with warm, silty water. The Black bass, bluegill, and perch occupy a wide range in relatively cool, larger streams, lakes, and reservoirs. Cold water species in the high elevation, clear spring-fed streams include various trout, mountain whitefish, and grayling.

Wildlife - Endangered Species. Priority consideration should be given to rare or endangered species. A few of these, characteristic of various grasslands are listed below; there are many others that should be carefully considered in more localized analyses:

North Temperate Grassland. Endangered: Black-footed ferret. Rare: Northern greater and lesser prairie chicken, prairie falcon, and greater sandhill crane.

Coastal Prairie. Endangered: Attwater's prairie chicken, whooping crane, and red wolf.

California Prairie. Endangered: San Joaquin kit fox, blunt-nosed leopard lizard. Rare: Tule elk.

Important threatened grasslands fish species are found primarily in the plains region. A few of the characteristic species are: White and pallid sturgeons, arctic grayling, east slope cutthroat trout, plains killifish and the plains topminnow.

Water

The major water supplies of the Grassland Biome are provided by the through-flowing rivers and streams of such major drainage basins as

the Missouri, western Upper Mississippi, middle Arkansas, White, Red, lower Rio Grande, Texas-Gulf, middle Columbia - North Pacific, and the California Central Valley. The larger rivers such as the Missouri, Yellowstone, Platte, Arkansas, Rio Grande, Columbia and Sacramento receive most of their water from the higher elevations above the grassland areas. Relatively lower grasslands receive about 8 to 24 inches of precipitation annually with eastern portions of the northern temperate and coastal prairie areas receiving up to 40 and 60 inches per year, respectively. Many of the smaller streams within the more arid grasslands are ephemeral rather than perennial. The quality of both surface and ground waters varies from area to area within the biome.

Surface Water resources within the grasslands include streams, rivers, reservoirs, lakes, marshes, potholes, and springs. These sources are utilized for such uses as domestic, municipal, industrial, power, agricultural, recreation and fish and wildlife purposes.

Except for the higher precipitation zones, annual runoff from the grassland is generally low. However, average annual runoff varies from less than 0.5 inch in the more arid areas to more than 20 inches along the coastal prairie of Texas and Louisiana.

The quality of water in most rivers, streams, lakes, and springs is generally adequate. Average dissolved solids (ions of sodium, the Missouri, between [illegible], middle [illegible], [illegible] Bell, Lodge and [illegible], [illegible], middle Yellowstone - [illegible], and the [illegible] [illegible] Valley. The larger rivers such as the Missouri, Yellowstone, [illegible], Big Horn, Clark Fork, [illegible] and [illegible] carry as well as [illegible] water from the higher elevations above the grassland areas. Relatively large grasslands receive about 8 to 20 inches of precipitation annually with western portions of the southern [illegible] and central [illegible] areas receiving up to 30 and 40 inches per year, respectively. Many of the smaller streams within the grasslands are [illegible] rather than permanent. The quality of both surface and ground waters varies from area to area within the state.

Hydrologic [illegible]. Resources within the grasslands include streams, rivers, reservoirs, lakes, marshes, potholes and springs. These waters are utilized for such uses as domestic, municipal, industrial, power, agricultural, recreation and fish and wildlife purposes.

Because of the highly [illegible] precipitation pattern, annual runoff from the grasslands is generally low. However, average annual runoff varies from less than 0.5 inch in the east [illegible] to more than 10 inches along the western [illegible] of [illegible] and [illegible].

The quality of water in most rivers, streams, lakes, and springs is generally adequate. Average [illegible] within [illegible] of [illegible].

calcium, etc.) vary from less than 100 parts per million (ppm) to more than 2,000 ppm. while average sediment concentrations in streamflow vary from less than 280 ppm. to more than 30,000 ppm.

Ground Water supplies vary within the grassland areas. Some areas such as the High Plains have large quantities of ground water. This resource is utilized for such uses as irrigation, domestic, and municipal purposes. The quality of ground water varies from area to area with a dissolved solid content ranging from less than 1,000 ppm. to more than 10,000 ppm.

Environmental Influences

Minerals

As might be expected from the geology throughout the Grasslands Biome, mineral deposits other than oil and gas will probably be confined to coal, those minerals classed as evaporites, and those found as replacement bodies in the sediments.

The evaporites may include such minerals as halite (sale), gypsum, potash, uranium, vanadium, some of the rare earth minerals, and also clays. Some examples of the replacement minerals are lead, zinc, barite, and fluorspar.

In the Great Plains Province, coal is generally found in the northern two-thirds, the evaporites in the middle one-third, north to south, and the replacement deposits scattered throughout the northern two-thirds.

The predominant locatable minerals are gypsum, vanadium, uranium, lead, zinc, barite, and fluorspar. The predominant leasable minerals are potash and clay. Mineral deposits are relatively minor in the California Prairie and Palouse Prairie, with the exception of gypsum found in the California Prairie.

Present oil and gas exploration activities in this biome are relatively heavy as compared with the total exploration efforts in the United States because of re-evaluation surveys. This biome is the major producer of all upland Federal oil and gas in the United States, primarily in the area just east of the Rockies.

Domestic Livestock. Historically, grasslands have been grazing lands and were the native habitat of the large herbivores prior to settlement by white man. During the period of early settlement these lands were used almost exclusively for grazing. Today beef, lamb, and wool are still the principal products of those portions that have not been converted to crop production. Some horses and goats are grazing on these lands, but this is a minor use.

In general, beef cattle production is the most important domestic livestock use of the grassland biome for the reason that cattle are better adapted to the type of forage produced than are sheep. Sheep become important on those portions of the biome where shrub species are a prominent component of the vegetation.

The trend in cattle numbers has been upward each year and sheep numbers have declined drastically. After a period of rapid decline, horse populations have reached a point of relative stability.

Human Settlement and Use Characteristics.

Population characteristics of the grassland biome exhibit extreme variability. Rural and undeveloped lands of a natural character make up the majority of the biome; however, the area also includes several complex urban centers with significant differences in population densities, economies, and social environments.

Most of the counties within the biome are very sparsely populated - densities over much of the area in 1970 were less than 10 persons per square mile, compared with the national average of 57.5. The area characterized by low density generally incurred a population loss in the 1960-1970 decade. Significant gains were experienced in most urban areas.

Low population densities and other characteristics of these rural-natural lands reflect economies and employment which are geared to resource production and primary processing. Agriculture and agricultural processing are principal economic activities. Mineral extraction and processing is taking on considerable economic importance, but tends to be localized. A limiting factor for industrial growth in much of the area is the isolation of resources from major market regions of the United States.

The recreation-tourism industry has grown rapidly the past 20 years, providing employment in the services sector of the economy.

Small communities are scattered throughout the natural-rural areas of the biome. The larger of these settlements (5-10 thousand population) are market centers and generally located along major transportation arterials. Extensive uses of the land for ranching, farming, and mining have a relatively low employment demand, reflecting low population densities. The economic and social environment tends to resemble a "frontier" economy. Economic and cultural disadvantages may be offset by a relatively high quality natural environment, a slow pace of life, and ready access to large areas of open space.

Numerous metropolitan areas are located in the eastern portions of the original biome. Of more direct concern are urbanized areas in the western portion which are in close proximity to extensive public lands. Significant western metropolitan areas include: Great Falls and Billings, Montana; Boulder, Denver, Colorado Springs, and Pueblo, Colorado; Spokane, Washington and the extensive Central Valley metropolitan complex within the California portion of the biome. Each of the above have country-city population levels exceeding 50,000. The Denver metropolitan area, for example, had a 1970 population of 1.25 million with a decadal growth rate of 32 percent during 1960 to 1970. If present trends continue, the prediction of an urban megalopolis stretching from Cheyenne, Wyoming to Pueblo, Colorado may become fact by the end of the century.

The metro areas have combinations of capital, labor, services, and a demand for products which support industrial development. The population concentrations support educational and cultural opportunities and a variety of housing and personal services. Economic and social environments are distinctly different from those of the natural-rural regions.

Land Uses.

The Homestead Act of 1862, railroad construction, irrigation, and other factors successfully encouraged cultivation of vast areas of the grassland biome. Areas remaining in a "natural" condition were typically unsuited for agriculture and may be in either private or public ownership. Extensive livestock grazing occurs on these "natural" lands throughout the biome. Extensive recreational uses (hunting; fishing, hiking, off-road vehicle use, etc.) occur also on this category of land, particularly on those tracts which remain in public ownership.

In the Great Plains area of the biome, intensive agriculture and percentage of private ownership increases progressively from west to east. This results in a general transition of: natural area - natural area/dryland farming - intensive agriculture going to the east. Irrigated areas, of course, would be an exception to this generalization. Cattle and wheat ranching predominate in the Western Great Plains. A large portion remains undeveloped providing

significant recreation opportunities. Also, within this area, roadless sections remain with primitive qualities which may be especially unique to the biome.

The California Central Valley portion of the biome contains extremely productive irrigated agricultural land. Production of nuts, fruits, vegetables, rice, and specialty crops are important nationally and internationally. Extensive livestock grazing occurs on undeveloped areas, as does recreational uses. Recreation is particularly significant because of the close proximity of large metropolitan areas.

Wheat grown by dry farming methods is the major agricultural use in the Palouse Prairie segment of the biome. Significant western portions remain undeveloped and are used for grazing.

The metropolitan areas within the biome are growing rapidly, imposing a demand for residential, commercial, and industrial expansion areas. Smaller communities may also require areas for growth, depending on local economic conditions. In nearly all cases, population concentrations place a demand on adjacent rural or natural lands for open space to provide recreational uses such as hunting, fishing, and pleasure driving by on- and off-road vehicles.

Mineral extraction is concentrated primarily in oil and gas production on portions of the Great Plains and in the southern portion of the California Central Valley. A number of surface, strip-mining coal

operations are in progress in the northern portions of the Great Plains Province. Some operations in gypsum, vanadium, uranium, lead, zinc, barite, fluorspar, potash, and clay are found throughout the Great Plains, but major concentrations of production are limited.

Aesthetic Values.

The form of the grassland may be described as primarily gently rolling hills and broad expanses of relatively flatlands. In some areas near major streams, particularly in drier portions of the biome, continuity of the land form may be interrupted by sharp breaks down to floodplains of the stream. Because of the relatively gentle slopes in the grasslands, most of man's activities seldom interrupt continuity of the form. Where the form is disturbed it is usually quite easily replaced to a natural or near-natural condition. Where the landscape is still in a natural state, the soft texture of the grass-covered slopes is interrupted by occasional rock outcrops. In drier portions ground cover may be in scattered patches with some exposed soil. Much of the eastern portion of the biome, along with the Palouse Prairie and the California Prairie, has been converted to agriculture. Here the texture changes from field to field as the crops change.

Although the texture of the grassland vegetation is easily disturbed, much of it has already been disturbed as it was converted to

agriculture. In those areas that are still in a natural condition, disturbance usually recovers quite quickly or can be made to recover to a near-natural condition very quickly.

Lines in natural portions of the biome play a minor role in the landscape and are evident only in ridgelines and in the occasional road or powerline crossing through the area. In the agricultural areas, lines become much more obvious. Crop rows, field edges, fence lines and roads become a dominant element in the landscape.

Color is not a dominant factor in the grassland biome. It may play a more important role in moist agricultural areas but in the natural and drier areas the colors are generally muted and tend toward a monotone.

Scale is difficult to define on the flat plane of the grasslands. Any vertical element which is introduced into the landscape has a tendency to define the scale but also draws the eye and becomes a focal point.

The total effect of the landscape character of the grassland biome will vary with the individual observer. To one, openness may connotate a freedom, room for movement, a challenge to action. Another may feel overwhelmed, lonesome, and unprotected. To some it may seem a monotonous wasteland. To the acute observer, subtle changes in tone or forms may be fascinating.

agriculture. In those areas that are still in a natural vegetational distribution (mostly forests, water bodies), line can be made to emerge in a man-induced condition very quickly.

Lines in natural portions of the study play a minor role in the landscape and are evident only in ridgelines and in the occasional view of meandering streams through the woods. In the agricultural areas, lines become much more evident. Stone rows, field edges, fence lines and roads become a dominant element in the landscape.

Color is not a dominant factor in the grassland sites. It does play a more important role in mixed agricultural areas but in the natural and open areas the colors are generally muted and tend towards a sameness.

Scale is difficult to define on the flat sites of the grasslands; any vertical element which is introduced into the landscape becomes a marker. In defining the scale it also draws the eye and becomes a focal point.

The user's picture of the landscape character of the grassland sites will vary with the individual observer. To one, openness may connote a freedom, a feeling for movement, a challenge to action. Another may feel monotony, boredom, and depression. To some it will seem a wilderness and unsafe. To the acute observer, subtle changes in tones of color may be fascinating.

Sound and smell, although they may be an important factor in a very localized area, are impossible to describe for an entire biome.

Geological Human Interest Values.

Human interest in geological phenomenon tends to center around these features which are different and strange or beautiful and exciting. Things like volcanic necks, caves with stalagmite formations, sinks, natural arches and bridges, fossils, erosional features, etc., arouse the interest and curiosity of the viewer. The grasslands biome has some of these features but being primarily a flat landscape, they are rather limited.

In the Northern Temperate Grassland are heavily eroded areas with some coloration like the Badlands of the Dakotas, dome mountains like the Little Rockies, canyons such as the Missouri in the Breaks, fossil beds, and volcanic remains such as Devils Tower, Wyoming.

The Southern Temperate Grassland contains, among other things, limestone caves in the Pecos River region, and sinkholes near Roswell, New Mexico.

The California Prairie contains dome mountains (Marysville Buttes) in the vicinity of Sacramento, and geologic faults with visible displacement, like the San Andreas Fault along its eastern edge.

The Palouse Prairie contains interesting geologic phenomena such as the scablands, the Grand Coulee, and other evidence of past volcanism in the region.

Archeological Values

Within the biome are found archeological sites of the three broad developmental stages of American Indian prehistory. These are the Paleo-Indian State, the Archaic State, and Agriculture State.

Both the eastern Big-Game Hunting Tradition and the Western Old Tradition occur within the biome. The Big-Game Hunting Tradition is recognized in kill sites of such animals as the bison, mammoth, camel, and horse. More rarely campsites are found with chipping and other camp debris. Some cave sites have been found. The Big-Game Hunting Tradition has been recognized in the Northern and Southern Temperate Grasslands.

The Old Cordilleron Tradition represents a relatively unspecialized hunting-gathering-fishing way of life. Evidence comes from old lakeshore campsites, caves, and deeply stratified refuse dumps in favorite fishing spots. The tradition has been found in both the Palouse and California Prairie Grasslands.

The second stage, the Archaic, is found as a Plains Archaic Tradition in the Northern and Southern Temperate Grasslands. During this stage more emphasis was placed on gathering of plants and some shell fish in addition to hunting. In the Plains Archaic, this is indicated in the sometimes deep trash dumps, dry cave sites, buried rock debris mounds, and campsites. Bison and other animal kill sites continue to be found, some of these being buffalo jumps with rock alignments.

The Eastern Archaic is found in the eastern portion of the Northern Temperate Grassland. It is similar to the Plains Archaic but with more emphasis on gathering - especially shellfish.

The Desert Archaic tradition is found in the Southern Temperate Grassland and had some input into the cultures found in the California Prairie. The Desert Archaic subsistence pattern was based primarily on small seed and small animal hunting. Archeological evidence comes mostly from campsites, dry caves, petroglyphs, and pictographs.

The third general stage of prehistoric development had cultures, for the most part, that were those found by the first non-Indians to visit the new world. The Agriculture Stage is represented in the Northern Temperate Grasslands by the Plains Culture (Woodland and Plains Village Traditions). Although reverting to a strong hunting culture once again after the introduction of the horse in the 1700's, the Plains Culture base originally was agriculture. Sites are predominantly surface and pithouse village sites (some stockaded), tipi rings and other rock alignments, pictographs and petroglyphs, caves, buffalo jumps and animal traps, log structures, vision quest sites, pole structures, and burial mounds.

In the eastern portion of the Northern Temperate Grasslands are also found remains of the Agricultural Stage, Northeastern Woodland Tradition

people with their temple and burial mounds, large village sites, and occasional cave sites.

Evidence of the Agricultural Pueblo Tradition is present in the northern portion of the Southern Temperate Grasslands. People who continued on at the Archaic Stage of development to contact times left remnants of their occupancy in the rest of the grassland. The Pueblo Tradition, here represented by the Mogollon Division revolves around sites of masonry buildings, pithouse dwellings, occasional irrigation systems, trash mounds associated with villages, pictographs and petroglyphs, cave use, fortified sites and roasting pits.

In the Palouse Prairie, agriculture was never developed by the native inhabitants so that the final pre-contact periods are represented here by the Norwest Riverine Tradition. These peoples lived along the river valleys and their archeological sites are mostly the remains of pithouses and above-ground houses in villages along the rivers, campsites, quarries, petroglyphs and burial grounds.

Similarly in the California Prairie, the Agriculture Stage never developed and the Archaic Stage continued up to contact times. Large shell middens occur near water, quarries, and village sites were added to the earlier Archaic Stage.

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Southern Temperate Grasslands were explored early by the Spanish but little happened for long afterward. Spanish settlements occurred in the Southern Temperate Grasslands in the 1700's. No real inroads into settling the various parts of the biome occurred, however, until about 1850 with the advent of gold discoveries in California and the Rocky Mountain west.

The California Prairie received some settlement in the Mexican Period but its agricultural greatness began as a supplier of foodstuffs for the 49'ers. The Palouse Prairie too was settled as an agricultural area in the mid 1800's.

Cultural, Ethnic, and Religious Values

Most prominent of the groups occupying the Grassland Biome are American Indian groups still living on the various reservations and still using, to some extent, the various lands of the biome for religious and cultural activities. In the southwestern portion of the biome are Spanish-American communities with their life-style somewhat dependent on lands outside their villages. Other ethnic-cultural-religious groups include Amish and Mennonite settlements in Iowa and Kansas, the monastaries and abbies, and various religious cults in California.

Many of the native cultures have areas of religious or mythological significance still in use and in need of recognition by other cultures. Many of the other ethnic and religious groups have needs that range from sensitivity as to their value systems to recognition of desires

to be left alone. In actuality, any small community or group determined to maintain its life style in the face of larger forces of change which threaten its existence deserves recognition of such desires.

Unique Management Problems.

Intensive livestock grazing management must pay particular attention to critical watershed areas, including the sandy soils and those high in fine clay; rare and endangered species; aquatic habitat; critical wildlife habitat, particularly for upland game birds; preservation of archeological, cultural, and historic values; and recreational uses, including aesthetics and open space.

Socio - Economic Factors

The grassland biome exists over approximately 36 percent of the 11 Western States (Table 4). Nearly 13 percent of the land area is managed by the BLM. Three and a half million of the 9.4 million people were employed in the grassland biome and earned total personal income of 32.2 billion dollars in 1970. Population density in the grassland biome is quite varied from area to area. Overall, the population density is 28.82 per square mile.

Nearly 160 thousand persons were employed in agriculture. Total agricultural sales of $3.4 billion were generated, of which nearly $1.5 billion or 42.7 percent was produced from cattle sales. An indication of the input that BLM makes to the livestock industry in

the grassland biome is the fact that 3.7 million AUMs of the total 102 million AUMs are produced on BLM range. This represents 3.7 percent of the total AUMs of livestock produced. BLM range is vital to many ranchers in various parts of the grassland biome. But, it is not critical to the overall economy of the biome; only to areas within the biome such as Southern New Mexico where 28 percent of the livestock AUMs come from BLM range.

2. Rocky Mountain Coniferous Forest Biome

Forests cover the Cascade and Sierra Mountains in Washington, Oregon, and northern California; and the northern and central Rocky Mountains extending into New Mexico; and the Wasatch and Uinta Mountains in Utah.

Except for a few locations, the higher mountains throughout this area, including the major timber stands, are within the National Forest System. Public lands under BLM administration are often fragmented parcels between the forest boundaries and irrigated valleys.

Topography

This biome consists of high mountains with moderate to steep slopes, narrow valleys with many terraces, and narrow bottom lands. Elevations vary from about 1500 feet to over 10,000 feet above sea level.

Climate

Climate is directly related to elevation - the higher it is, the colder and wetter the climate.

Annual precipitation at the lower levels generally averages about 16 inches. Higher elevations are quite different with the Sierras in California receiving 50 inches, the Cascades 90 inches, and the Rockies 30 inches. Average January precipitation varies from 8 inches along the Sierras and Cascades to 1-3 inches in the Rockies and from 1 inch or less along the Sierras and Cascades to 2-3 inches in the Rockies

during July. Average daily minimum temperatures during January range from 20° F at the lower elevations to 0° F at the higher elevations. Maximum temperatures during July average 85° F at the lower elevations to 70° F at higher elevations. The mean daily temperatures average about 10° warmer during January and 10° colder during July.

Wind directions and velocities are subject to topography and considerable convective activity, especially during the summer months. At the summits of the mountains, the winds are generally from the west and are frequently very strong in the winter and spring.

There is considerable thunderstorm activity in this mountainous country - especially over Colorado and New Mexico - where the incidence of thunderstorm activity (50-70 per year) is exceeded only in Florida and the Gulf Coast.

Vegetation:

Coniferous trees are the predominant form of vegetation covering extensive areas ranging from the Pacific Coast to the grasslands in the East. The identifying life-form is the needle-leaved evergreen tree, especially spruces, firs, and pines which form a relatively continuous canopy over the forest floor. Thus, a dense shade exists year around, often resulting in poor development of shrub and herb layers. However, the continuous blanket of chlorophy present the year around results in a fairly high annual production rate and the open park-like forests and alpine meadows provide important summer grazing for livestock and game animals.

Composition of the forest vegetation is influenced to a large extent by elevation resulting in four basic vegetational zones. Proceeding upward from the lowlands these include woodlands, forest,subalpine forest, and alpine meadows. Due to the comparatively high rain or snowfall, a profusion of water bodies and courses are distributed over the forest supporting an abundant variety of aquatic species of plant life. In addition to the actions of man, natural forces in the form of bark beetles, defoliating insects, disease, and fire exact annual losses to the vegetation. However, such outbreaks are part of a continuous cycle of development to which the coniferous forest ecosystem is adapted to through rapid plant establishment and succession.

Harvesting of timber to provide wood products characterizes most of the biome, historically as well as presently. In contrast to the eastern Deciduous Forest, many sections of the Coniferous Forest are untapped in terms of timber harvesting activities and are in their natural state. Forest vegetation provides aesthetic and recreational values and acts as a soil stabilant in protecting extensive watersheds for man's enjoyment and use. The vegetation also provides shelter, protection, and food to the many forms of wildlife that dwell in the forest. Over time the area supporting forest vegetation has been reduced somewhat to provide for agricultural crop production and urban development.

In lower elevational zones, primary species consist of Douglas-fir, Engelmann spruce, ponderosa pine, lodgepole pine, and aspen. In higher zones, sub-alpine and alpine conditions exist with grassland meadows interspersed with dense stands of sub-alpine firs and Engelmann spruce. In addition to being an important timber producing region, it embraces large areas devoted to recreation and wilderness use.

Soils:

Soils in the Coniferous Forest Biome range from the Inceptisols in the cool wet climate to the Mollisols in the warm dry climate. Soils in most of the orders range in depth from very shallow to very deep, from sandy to clayey in texture, from very stony to non-stony, occur on topography that ranges from nearly level to very steep and range from poorly drained to well drained. Criteria that separates soils at the order level is very broad and is based on the weathering characteristics rather than behavior to management. It is therefore necessary to obtain local, more detailed soils information when considering management alternatives.

Inceptisols and Ultisols generally occur in the higher elevations and areas receiving larger amounts of precipitation. Ultisols have clay enriched subsoils, are acid in nature, and may have light or dark colored surfaces. Characteristics of the Inceptisols vary greatly. The soils in these two orders occur in northeastern California,

Western Oregon and Washington, adjacent to the Canadian border in northern Idaho and northwestern Montana, and south in the Rocky Mountains to central Idaho. A few Spodosols will be intermingled.

Alfisols occur in areas receiving less rainfall. Therefore, amount of bare ground is higher. Alfisols have a clay enriched subsoil and a grey-to-brown surface soil. Large areas of Alfisols are located on the east and west sides of the Sacramento Valley in California and areas on the east front of the Rocky Mountains in Montana, Wyoming, and Colorado.

Mollisols have a high base status, have a surface enriched in organic matter, and have dark-colored surfaces. Mollisols are located in the southern Rocky Mountains in Utah and Arizona. The Mollisols range from cold to warm climate.

Entisols are young soils lacking diagnostic horizons. They occur in areas having recent deposits of alluvium, on very steep, gravelly slopes and on areas of recently stabilized sand dunes. These soils occur in western Colorado, northwestern New Mexico, and central Utah.

Aridisols are generally associated with the desert as they have prolonged dry periods. However, there are areas of Aridisols supporting coniferous forests in New Mexico and Arizona.

Coniferous needles decay slowly and the forest soil develops a characteristic podzal profile.

The forest biome includes caribou, moose, mountain goat, spruce grouse, and the mountain pine beetle. Elk and mule deer occupy openings and seral stages of the forest. Smaller animals of this forest include the porcupine, snowshoe rabbit, long-tailed weasel, striped skunk, flying squirrel, red squirrel, pocket gopher, deer mouse, western jumping mouse, and vagrant shrews. Fifty-six species of breeding birds have been recorded in the central Rocky Mountains. To the south, the Kaibab squirrel and tawny deer mouse are most abundant.

In the Oregon-California portion of the forest, mountain quail, band-tail pigeon, Oregon junco, pygmy owl, and the California mountain kingsnake are common. A number of destructive insects feed on the trees, such as: spruce budworm, Douglas fir beetle, mountain june beetle, and Jeffrey pine beetle.

Inland waters of the coniferous biome that do not empty directly into the sea are characterized by high quality, low temperatures, and a fair grade of aquatic food.

High elevation streams support trout, whitefish, and sculpin populations. Lower streams support chub, carp, dace, and suckers mixed with populations of salmonids. Other common fish are black bass, sunfish, catfish, pike and minnows.

West Coast streams produce the anadromous steelhead and five commercially important species of salmon: the chinook, sockeye, chum, pink, and coho. Migratory populations of coastal cutthroat trout are present in many coastal streams from California northward.

Endangered Aquatic Species -- included are:

Westslope Cutthroat Trout, Montana
Arctic Grayling, Montana
Colorado River Cutthroat Trout, Colorado and Wyoming
Greenback Cutthroat Trout, Colorado
Little Kern Goldentrout, California
Olympic Mudminnow, Washington
Snake River Cutthroat Trout, Wyoming

Endangered Terrestrial Species are:

Kaibab squirrel (rare) - Arizona
Grizzly bear (rare) - northern Rockies
Woodland caribou (scarce in U.S.) - periphery of range
Mountain caribou (scarce in U.S.) - periphery of range
Pine marten - northern U.S.
Fisher - northern U.S.
Wolverine - northern U.S.
Canada lynx - northern U.S.

Water

Water resources of the coniferous forests provide most of the water needs for the Western United States. These forest areas supply major rivers and streams flowing from the forests and subsequently through the other biomes (grassland, desert, etc.). They are also largely responsible for recharge to the ground water aquifers of adjacent woodland, grassland, and desert areas. Generally higher elevation coniferous forests vary in annual precipitation received from as low as 10 inches to a high in excess of 200 inches at some stations along the coastal areas of northwestern Washington. Streams of the coniferous forests are largely perennial although some may be intermittent in regions where extended dry periods normally occur during certain seasons (i.e., along the coasts of Oregon and Washington during the summer). Coniferous forests are water surplus areas because of the large amounts of precipitation, and provide generous quantities of high quality water which, in many areas, exceed the demand.

Surface Water.

Large quantities of surface water found in the coniferous forest biome occur as streams, rivers, lakes, reservoirs, springs, marshes, and potholes. These water resources are used for power, industrial, municipal, agricultural, recreation, and fish and wildlife purposes. Natural lakes are an important part of the surface water resources of the coniferous forest biome.

Water yield from the coniferous forests is generally plentiful ranging from about 5 inches annually in the southern Rocky Mountains to over 150 inches annually in parts of northwest Washington. This water is yielded largely during the spring and early summer months in the higher elevations where precipitation occurs mostly as snow. However, along the lower elevation coastal areas of northern California, Oregon, Washington and southeastern Alaska where precipitation occurs during the winter, predominantly as rainfall, most of the runoff comes during the period of November through March.

Quality of most surface waters in the coniferous forests is good to excellent. Average dissolved solids (ions of sodium, calcium, chloride, etc.) generally are below 100 ppm. (parts per million). Sediment concentrations found in coniferous forest streams are generally low (usually less than 280 ppm.).

Ground Water. Ground water supplies in the coniferous forests are generally adequate although not so important a source as in the grassland, desert, and woodland biomes. Because of the normal surplus of surface water, ground water use and demand in the forest area is generally low.

The quality of ground water is generally good in the forests with a dissolved solid content that normally is less than 1,000 ppm.

Environmental Influences.

Minerals

Locatable mineral deposits are probably more pronounced in this biome than in any of the others. These deposits are principally of the vein type and closely associated with the Laramide Orogeny of the Rocky Mountains, the Sierra Batholith, and the Idaho Batholith. Deposits are distributed throughout the biome with the exception of few, if any, being found in coniferous forests in east-central Arizona and west-central New Mexico, Wyoming, and southeast Montana.

Leasables again are the evaporite bedded type and appear to be found on the flanks of the mountain ranges. Coal in this biome is of all types, ranging from Anthracites through Bituminous to Lignites. Few, if any, leasable mineral deposits are found in those portions of the biome in northeastern Washington, northeastern Oregon, Idaho, northwestern Montana, and central Arizona. It is unlikely that other leasable and locatable mineral deposits will occur in areas of primary importance for oil and gas.

It could be said that almost all types of the locatable minerals can be expected to be found in this biome. The following are only the most predominant ones: gold, silver, copper, lead, zinc, iron, manganese, chromium, cobalt, nickel, molybdenum, vanadium, tungsten, niobium, tantalum, tin, fluorspar, barite, sypsum, magnesite and brucite. The leasables are potash, borates,sulfur, coal, and phosphate.

Domestic Livestock

Grazing by livestock in the coniferous forest occurs largely on mountain meadows interspersed as small vegetative islands throughout the biome and in open stands of timber where forage species grow among sparse stands of trees.

Both cattle and sheep graze these areas, with cattle generally concentrating on lower elevations and sheep on higher elevations. The upper elevations on into the subalpine and alpine zones are grazed exclusively by sheep. Some horse use occurs in connection with recreation activities, such as riding and pack trips, but this is relatively minor. Most livestock use occurs between June 15 and October 1.

Over the years, livestock use has declined on the coniferous forests because of withdrawal of portions from grazing for watershed protection purposes. This trend could continue as demand for water increases in the West.

Human Settlement and Land Use

Most of white man's early settlement in the biome began with search for gold and silver. Some were successful and towns sprang up quickly. Many early mining settlements have either disappeared or are ghost towns today. Others which were favorably situated, survived. Several counties in Colorado, Idaho, Oregon and Washington had the greatest populations prior to 1920 and have since decreased. Large national forests and parks in the area have virtually no permanent year-around habitation.

Forest products, mining, agriculture, and tourism are major sectors in the economy. Lumbering and livestock grazing occur generally throughout the biome. Ranches or small farms are usually located along streams or river valleys, where small areas may be cultivated. Mining, while not as extensive as lumbering or grazing, occurs in certain locations and provides significant income and employment.

Recreation-tourism is growing rapidly in importance. In areas with outstanding resources, such as the Yellowstone Park area, or Aspen, Colorado, tourism is the mainstay for local communities. The forest has very high general recreational potential and is significant on a national basis for this land use. Acreage of designated wilderness and undeveloped lands is substantial.

Communities tend to be small, and reflect logging, ranching, or mining which may occur in the area. Southern portions of the biome retain, in part, the culture of early Spanish settlement.

Aesthetics

Coniferous forests provide what are probably considered the most spectacular scenic values of all biomes. Land form varies from rounded foothills of the Cascades to angular peaks of the Rockies, from relatively flat mesas and basins to nearly vertical canyons.

Textures vary from the relatively soft continuous forest canopy of the west slopes of the Cascades to the broken patches of trees among rocks

at higher elevations of the Montane regions. Colors generally reflect the green of the conifer cover. However, in the higher elevations as the vegetation becomes more sparse, colors of the exposed rock and soil become apparent.

Lines are probably more obvious in the natural environment of the coniferous forest biome than in any other. There are many abrupt changes in vegetation types caused by a change in soil, an avalanche path, or an intrusion of rock. There may be lines in the sharp angular surface of exposed rock.

Scale, though easily defined, may become almost overpowering in some areas. Many people are not accustomed to the extreme vertical relief common to this biome. The overall effect again varies with the background of the individual observer. To some, mountains are a frightening experience - to others they are a comfortable place to be. The wide variety of forms, textures, colors, and lines are what make the scenic values in the coniferous forest biome interesting, while vastness of scale and distance bring an awesome feeling of isolation to most sojourners within this region.

Geological Human Interest Values

In the Montane coniferous forest are found geologically interesting features such as those left by glaciation such as morains, lakes, U-shaped valleys; erosion features like canyons, pinnacles, peaks

and mudlows; volcanic features such as lava flows, eroded ash beds, dikes, exposed plugs, and calderas, hot springs and geysers.

Archeological Values

The forests themselves were not generally lived in by native Americans. They lived along the water courses and used the forests for hunting and gathering. The peoples of the desert and grassland biomes used the coniferous forest biome that was within range of their seasonal traveling ability.

Historical Values

The coniferous forest tends to share its history with the nearby grasslands and desert and use was somewhat like the prehistoric use in that most of the settlements occurred in the valleys and few really lived in the forests to any great extent.

Cultural, Ethnic and Religious Values

Most of the coniferous forest is too high for any permanent Indian settlements although they are nearby in the valleys and lower lands. Other ethnic/religious groups using the Montane Coniferous Forest are those of the surrounding grasslands and deserts.

Unique Managment Problems

High mountain meadows and berbaceous understory vegetation provides important summer forage for wild herbivores and domestic livestock. Intensive livestock management must consider preservation of the

meadow ecosystem; aquatic habitat, particularly stream banks and shorelines; rare and endangered species; minimizing competition for browse between big game animals and livestock; preservation of the scenic and recreational values; and maintaining protective vegetative cover on the watershed.

Socio-Economic Factors

The Rocky Mountain Coniferous Forest Biome exists over approximately 102 million acres in the 11 Western States (Table 4). The nearly 2.9 million people in the biome live in communities which are isolated by large expanses of open space. Overall, the population density of the biome is 18.1 people per square mile.

The BLM administers 8.66 percent of the land area within the Rocky Mountain Coniferous Forest Biome. Total employment within the biome is just over a million persons and they generate 8.8 billion dollars of personal income. Agricultural employment is nearly 61 thousand persons, which is over 16 percent of the total work force.

Total agricultural sales were $705 million in 1970. Cattle sales were $161 million or nearly 23 percent of total agricultural sales. The BLM provided nearly 5 percent of the total forage AUMs for sheep and cattle in the biome.

The impact of public grazing upon the economy of the biome is varied. In some areas of New Mexico, Colorado, Oregon, and Idaho the influence of cattle and sheep ranching is very high upon the local economies of the immediate area. In others, the influence is negligible.

3. Desert Biome

This biome is found where precipitation is too low to support grassland or woodland vegetation. It is divided into two subtypes: cold deserts and hot deserts. The former have warm summers and cold winters while the latter range from moderately warm in winter to extremely hot in summer. Basically, the delineation is as follows:

Cold Desert. Extends from central Washington through eastern Oregon, southern Idaho, southwestern Wyoming, northeastern California, northern Nevada, northern Arizona, northwestern New Mexico, Utah, and western Colorado. (This area is sometimes referred to as the High Desert, Great Basin Desert, and Painted Desert.)

Hot Desert. Extends at lower elevations through southeastern California and the southern portions of Nevada, Utah, Arizona, and New Mexico. Sometimes it is referred to as the Mojave Desert, Lower Colorado River Desert, or Sonoran Desert.

Direct Federal land ownership and control of subsurface minerals is high throughout this biome. With the exception of railroad grants across central Utah, northern Nevada, and southwestern Wyoming, BLM administered national resource lands are quite well consolidated, ranging from 50 to 80 percent public ownership in the various States.

Topography. The desert biome occupies portions of two large physiographic provinces, the Basin and Range Province and the Intermontane Plateaus.

The Basin and Range Province is characterized by plains broken by low to high mountains. The Desert Biome within the Intermountain Plateau includes the southern portion of the Columbia Plateau in southeast Oregon and southwest Idaho; it also includes the Colorado Plateau in eastern Utah, western Colorado, northern Arizona, and northwest New Mexico. This Province is recognized as the most extensive active fault area on the North American Continent.

The Columbia Plateau is broken relief with plains, medium to high hills and table lands with considerable relief; while the Colorado Plateau is characterized by table lands with moderate to very high relief.

This biome is very irregular topographically and hence is variable in soil and climate. Elevations vary from a low of about 200 feet or less in southeastern Washington, eastern Oregon, and in parts of California to over 7,000 feet in southwestern Wyoming. Some small area of the hot desert is below sea level.

Climate. Climatic conditions within the Desert Biome are characterized by low erratic precipitation, strong winds (especially in the spring), and hot summer temperatures. The Desert Biome's two subregions, the Cold Desert and the Hot Desert, are basically defined by their differing climates.

The Basin and Range Province is characterized by alpine broken lies in high elevation. The Desert Biome within the Intermountain Plateau includes the southern portion of the Columbia Plateau in southeast Oregon and southwest Idaho. It also includes the Colorado Plateau in eastern Utah, western Colorado, northern Arizona, and northwest New Mexico. This province is recognized as the most extensive arid land area on the North American continent.

The Colorado Plateau is broken relief with plains, mesas on high plains and table lands with considerable relief, while the Columbia Plateau is characterized by basalt lava with outcrops of very high relief.

This biome is very irregular topographically and there is variation in soil and climate. Elevations vary from a low of about 250 feet or less in northwestern California, western Oregon, and in parts of California to over 7,000 feet in southwestern Colorado. Some small area of the Salt Desert is below sea level.

Climate. Climatic conditions within the Desert Biome are characterized by low annual precipitation, strong winds, high radiation quickly, and hot summer temperatures. The Desert Biome's two conditions. The Cold Desert and the Hot Desert, are generally defined by their differing climates.

Cold Desert. This northern zone lies in a belt of westerly cyclonic storms. These storms bring most of the annual precipitation during the winter and early spring months except for Wyoming. Average annual precipitation ranges from four inches in desert valleys to 16 inches on higher plateaus.

Temperatures range from 20° F below zero to 115° F above; with mean daily temperatures varying from 20° F in January to 75° F in July.

Mean wind direction and velocities tend to remain similar during winter and summer months; however, spring is the windiest time of the year with winds of 40 mph not uncommon. Strong winds, carrying sand at this time of the year, help sculpture the landscape in this arid section of the United States. Especially in the valleys of the desert, atmospheric subsidence causes temperature inversions which result in blankets of fog covering inland basins for several days at a time. These conditions pose serious air pollution problems for relatively short periods.

Hot Desert. The southern zone is influenced by rather infrequent frontal systems during the winter that bring some moisture in from the west and north. During the summer, thunderstorms drop scattered moisture throughout the area. There are infrequent penetrations of moisture from the Gulf of California, the Pacific, and the Gulf of Mexico. Average annual precipitation ranges from two inches in the Lower Imperial Valley to eight inches in the remainder of the area.

Temperatures range from 20° F to 125° F above zero, with the mean daily temperature varying from 55° F in January to above 90° F in July.

Spring months tend to be windy with sand-carrying winds of over 40 mph not uncommon. Other months experience similar direction but somewhat lighter wind velocity. Late summer thunderstorms occur with more frequency in the Hot Desert than the Cold Desert area with the exception of central Wyoming where 40 to 50 days of thunderstorm activity take place.

Within both zones, there is a great diversity of local climates, ranging between extremes of humid, cold, torrid, and dry. Wide local variations are caused primarily by topography but depend, too, on general air circulation, relative position in the Desert Biome, and latitude. There are wet periods and dry periods -- in some years, a marginal area will be favored with an unusually large share of moisture-laden winds. Rain will fall, plants will thrive. In other years, winds are dry, and the desert community suffers. Extended periods of drought are not uncommon in the Desert Biome.

Vegetation. Contrary to popular opinion, the desert supports extensive communities of plants, which essentially consists of three life-forms:

1. The annuals, which avoid drought by growing only when there is adequate moisture.
2. The succulents, such as the cacti, which store water.
3. The desert shrubs, which have numerous branches originating from a short basal trunk bearing small leaves that are shed during prolonged dry periods.

As such, they all have in common characteristics necessary to survive arid conditions which typify the desert biome. Together they are an important source of both food and shelter to the many forms of animal life that prevail.

All desert vegetation has a highly characteristic "spaced" distribution in which individual plants are thinly scattered with large bare areas in between. In addition to the characteristic cacti and sagebrushes, these plants include forbs, grasses, shrubs, and even trees. The Joshua tree with its odd misshapen form and unique leaves is perhaps one of the better known tree species found in the Hot Desert. The extensive "bare ground," however, is not necessarily free of plants. Mosses, algae, and lichens may be present to form a stabilizing crust in addition to function as nitrogen-fixing agents. Besides perennial species of plant life, there also exist many species of annual forbs and grasses which make quite a show during brief wet periods.

The desert environment offers particular advantages to these short-lived plants insofar as relieving them of difficulties of water supply which beset perennials.

The cold desert is characterized by sagebrush, greasewood, shadscale and saltbush while creosotebush and yucca, along with cactus, typifies the hot desert. In the eastern sector of these deserts, a considerable amount of grass is mixed with the shrubs; however, it has suffered from misuse,and fire protection has permitted shrubs to invade former grasslands.

Unlike grasslands and forests in more humid climates, where vegetation renewal begins relatively quickly on disturbed areas, the desert is essentially lacking in plant succession. If a desert plant community is denuded, plants that ultimately return are usually the offspring of the original species. Exceptions often take the form of such noxious species as halogeton which is poisonous to sheep and cattle. Nevertheless, there is no discrete series of weed, grass, shrub, or tree storage to succeed one another -- preparing or ameliorating the soil, or providing shade for the next stage to follow. Consequently, the restored community is the one that was there in the beginning, often taking decades to re-establish itself.

During favorable moisture years, annual plants may produce as much as 4,000 pounds per acre in the hot desert and significant amounts in the cold desert where cheatgrass is prevalent.

Soils. The cold desert generally contains three soil orders. The dominant order is the Aridisols. Aridisols occur in south central Idaho, southeastern Oregon, central Washington, Nevada, and western Utah. This order is very extensive and quite contiguous. Aridisols have prolonged dry periods each year and have light colored surface soils.

Mollisols are the second most extensive soils occurring in the cold desert. They occur in eastern Washington and Oregon, southeastern and southwestern Idaho, central and southwestern Utah, and northeastern California. Mollisols associated with the cold desert have a prolonged dry period each year.

Entisols are young and essentially non-developed. Entisols are found in recent alluvium, recently stabilized sand dunes, or on steep slopes subjected to rapid soil creep. Areas of Entisols are located in south central Oregon, western Nevada, and central Utah.

Soils of the hot desert biome belong in the Aridisol soil order. These soils are found in southeastern California, southern Nevada, southern Arizona, and southwestern New Mexico and are hot, dry, and low in fertility. Basically, the Aridisols contain two suborders

Under favorable moisture season, annual plants may produce as much as 4,000 pounds per acre in the hot desert and significant amounts in the cold desert where cheatgrass is prevalent.

Soils. The mixed desert generally occurs [illegible] soil orders. The dominant order is the Aridisols. Entisols occur in [illegible] [illegible], [illegible], [illegible], [illegible], and [illegible] [illegible]. This order is very extensive and quite continuous. Aridisols have developed [illegible] surface horizons and have light colored surface soils.

Mollisols are the second most extensive soils occurring in the cold deserts. They occur in [illegible], [illegible] Oregon, [illegible] and [illegible] Idaho, central and [illegible] Utah, and northeastern California. Mollisols associated with the cold desert have a prolonged dry period each year.

[illegible] are found [illegible] [illegible]. [illegible] are [illegible] [illegible], [illegible], [illegible] [illegible] [illegible], or [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible], and [illegible] [illegible].

Soils of the hot [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. These soils are found in southeastern California, southern Nevada, southwestern Arizona, and [illegible] New Mexico, [illegible], and [illegible] in [illegible]. [illegible], the Aridisols [illegible] [illegible] [illegible].

known as (1) Orgids and (2) Orthids. Both of these suborders have a characteristic hardpan or duripan, but differ in structure and composition as follows:

Hardpan developed under the suborder Orgid consists of an accumulation of clays and the suborder Orthid is composed of an accumulation of calcium carbonate, bypsum, and other salts.

Erosional and depositional features of the desert soils vary considerably, dependent upon soil surface conditions, sub-surface characteristics, slope, and climate.

Susceptibility to wind and water erosion is high because the hot desert soils are loose, single grained, and easily detached. Surface disturbance by machines and removal of the vegetative cover accelerates erosion.

Soil organisms play the same basic role in soil development in the Desert Biome as they do in other Biomes (e.g., the previously discussed Grassland Biome). However, the supply of organic matter is much more limited in desert soils and its breakdown by micro-organisms, such as nematódes and protozoa, is much slower. This is due to the unfavorable conditions for the growth and activity of such organisms. While the soil is often warm enough, sufficient moisture is very seasonal and discontinuous. Some desert soils are largely devoid of plant life and micro-organisms that would help known as (5) [illegible] and (6) [illegible] . Both of these elements have a [illegible] [illegible] or depth, but differ in structure and composition as follows:

[illegible] [illegible] [illegible] [illegible] [illegible] consists of an [illegible] [illegible] of [illegible] but the subsoil [illegible] is composed of an [illegible] of [illegible], [illegible], and other [illegible].

Chemical and [illegible] [illegible] of the [illegible] soils vary [illegible], depending upon soil surface conditions, [illegible] [illegible], [illegible], and climate.

[illegible] [illegible] [illegible] [illegible] [illegible] in high [illegible] [illegible] [illegible] [illegible], [illegible], and [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] removal of the [illegible] [illegible] [illegible].

Soil [illegible] [illegible] [illegible] [illegible] [illegible] in soil [illegible] of the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], the [illegible] [illegible] [illegible] [illegible]. However, the [illegible] of [illegible] [illegible] such as [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. This is [illegible] [illegible] [illegible] for the growth and [illegible] of such organisms. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

develop conditions to support such life due to harmful excesses of salts such as are found in the dry lakebeds of the hot desert.

Animals.

Wildlife - Terrestrial. Desert communities are of intense interest for the extremes of adaptation to the environment by both plants and animals. Animal life is characterized by fleetness of foot in both mammals and birds; jumping or ricocheting locomotion among animals, and their keen sense of hearing; burrowing in all vertebrate types and in many of the insects and arachnids (spiders, etc.); and extreme physiological adaptations to food scarcity and to absence of free water. Some desert animals do not need to drink water (e.g., kangaroo rat, pocket mouse); others drink water at least occasionally, such as most birds of the desert which may exist on dew, but which are most abundant near a free water source. Many, if not most, animals of the hot desert avoid temperature extremes by burrowing or occupying caves; many are nocturnal.

In the lower Colorado Basin of Arizona and adjacent areas, there are more than 750 species and subspecies of birds and mammals. Not all of these are strictly desert species. Many may occupy only the fringes seasonally, such as the large ungulates which are almost absent from the desert. Carnivores are small and usually nocturnal. Species of kangaroo rat and pocket mouse are characteristic throughout the hot desert; both are nocturnal burrowers. Burrowers are

very beneficial in moving soil from lower levels to the surface, mixing in organic matter, and in planting seeds.

Typical hot desert animals include: black-tailed jack rabbit, desert coyote, kit fox, antelope, ground squirrels, cave bat, big brown bat, leaf-nosed bat, lesser nighthawk, road runner, and Gambel quail. In the Sonoran Desert of Arizona are ringtail, spotted skunk, wood rat, peccary, Gila woodpecker, numerous small birds during winter, bullsnake, three species of rattlesnake, and eight species of lizards. The Gila monster is typical of the cactus community. River bottoms and flood plains, typical of more mesic areas, include some 32 kinds of birds. The Mojave Desert of southern California has fewer species of pocket mouse, no Gila monster, but otherwise many of the same animals with some differences in subspecies. The desert iguana and desert tortoise are commonly found here. The yucca moth pollinates the Joshua tree. Death Valley has 39 desert mammals and approximately 100 species of birds.

Northward, in the sagebrush and shadscale of the cold desert, many of the same animals are found. Major influents here, however, are Great Basin coyote, badger, antelope, mule deer, great horned owl, prairie falcon, Swainson's hawk, golden and bald eagles, horned lark and horned toad. There are fewer reptiles.

Wildlife - Aquatic. All waters become important to aquatic animals in the arid conditions of the desert. Water shortage is emphasized by increasing human populations need for water, especially for agriculture. Diversion of water for irrigation contributed to the deterioration of fish habitat in Pyramid and Walker Lakes, Nevada, once the home of Lahontan cutthroat trout and the depleted Cui-ui sucker.

A wide range of water quality exists from the high barren desert mountain snow water to the very alkaline lakes such as the Salton Sea.

Man has altered desert aquatic environment through the construction of large reservoirs such as Lakes Powell and Mead, to small irrigation and stock watering reservoirs. Introduced exotic species such as black bass, crappie, carp, sunfish; the salt water species Corvina, Sargo, and Bairdiella in the Salton Sea, and striped bass and coho salmon in some reservoirs and tailwaters all appear to do well while many endemic native species are reduced in numbers.

Wildlife - Endangered Species. In the Great Basin region, one mammal is classified as endangered. It is the Utah prairie dog whose range is mostly in Piute County, Utah. The American Peregrin falcon is endangered and the prairie falcon is listed as rare. In the lower Colorado River region, in addition to the Peregrin falcon, rare

species are the Sonoran pronghorn, and four birds: Mexican duck, Masked Bob-White, Yuma Clapper Rail, and Southern Bald Eagle. Rare species are listed as: Spotted bat, Kaibab squirrel, and the Vegas Valley leopard frog (in Clark Co., Nevada).

There are more rare or endangered species of fish in the desert than in any other biome. This would be due, in part at least, to the many isolated watersheds. The principal threatened fishes are listed below:

- Cutthroat Trout subspecies (names by location of habitat):
  - Colorado River in Colorado
  - Rio Grande in New Mexico, Colorado
  - Lahontan in Nevada
  - Gila in Arizona, New Mexico
  - Alvord in Oregon
  - Piute in California
  - Redband in California (McCloud R. Basin), Oregon
- Pupfish subspecies (named by location of habitat):
  - Desert in Arizona, California
  - Tecopa in California
  - Shoshone in California
  - Owens in California
  - Devils Hole in Nevada (occurs in one pond)
  - Ash Meadows in Nevada
  - Warm Spring in Nevada

Killifish subspecies:

Pahrump in Nevada (occurs only in Manse Ranch pool)

Dace subspecies:

Owens Speckled in California

Desert in Nevada

Moapa in Nevada (occurs only in Muddy River)

Spikedace in Arizona

Little Colorado River Spindace in Arizona

Chub subspecies:

Pahranagat Roundtail in Nevada, Arizona

Humpback in Colorado, Utah

Least Chub in Utah, Snake Valley

Mojave in California

Squawfish in Colorado, Utah, Colorado R.

Other rare and endangered fish species are the Woundfin in Arizona, Utah, and Nevada; Gila Topminnow, Gila drainage Arizona and New Mexico; Bonytail, California, Nevada; the White Sturgeon, Idaho; Cui-ui Sucker, Pyramid Lake, Nevada; and the Pecos Gambusia, New Mexico.

Water. Most of the water resources of the desert biome are supplied by larger rivers and streams of such water supply regions as the Columbia-North Pacific, Great Basin, Upper Colorado and Lower Colorado.

Major rivers of these regions include the Snake, Columbia, Humboldt, Green, and Colorado, and they receive most of their runoff from the higher elevations above the desert areas. The desert biome receives from less than three inches of precipitation annually in the hot desert of the Lower Colorado Region to more than 16 inches per year in parts of the cold desert of the other regions. Many streams within the arid desert biome are ephemeral rather than perennial and provide little in the way of water resources. Almost all runoff from the desert areas is fully committed to agricultural, stock watering, and related uses. The quantity and quality of both surface and ground water varies from area to area within the hot and cold deserts.

Surface Water. Of the water resource regions mentioned previously, only one is a closed basin -- the Great Basin. Surface waters of this basin drain into inland water bodies such as Great Salt Lake, Sevier Lake, Pyramid Lake, and Humboldt Lake. The balance of the desert water basins eventually drain into the sea. Surface water resources within the desert areas include streams, rivers, reservoirs, lakes, springs, marshes, and pot holes. These sources are presently fully committed for such uses as agricultural, power, municipal, domestic, industrial, recreation, and fish and wildlife purposes.

Average annual runoff from the desert is very low and fluctuates greatly from one year to the next. It varies from less than 0.1 inch

annually in the most arid section of the hot desert to more than 2 inches per year in higher precipitation zones of the northern cold desert.

Quality of water in most rivers, streams, lakes, and springs is generally adequate. However, in the Lower Colorado Region some waters are high in dissolved solids and/or sediment concentrations. Average dissolved solids (ions of sodium, calcium, etc.) vary within the desert biome from less than 100 ppm. (parts per million) in part of the Columbia-North Pacific Region to more than 2,000 ppm. in some areas of the Great Basin and Lower Colorado Regions. Average sediment concentrations in streamflow vary from less than 280 ppm. in part of the Columbia-North Pacific Region to more than 30,000 ppm. in northern Arizona and southwestern Utah. While averages for the latter area may range around 30,000 ppm., sediment concentrations as great as 700,000 ppm. have been measured during peak flows on some streams.

Ground Water. As would be expected in such arid areas, ground water supplies vary within the hot and cold deserts. Good quantities of ground water exist in such desert areas as the Columbia Lava Plateau of the Columbia-North Pacific Region and the alluvial basins of the Great Basin and Lower Colorado Regions. Ground water of the desert biome is utilized for such purposes as irrigation, domestic, stock watering, and municipal supplies.

Quality of ground water varies from area to area with a dissolved solid content ranging from less than 1,000 ppm. to more than 35,000 ppm.

Environmental Influences.

Domestic Livestock. The Desert Biome produces a variety of forage species that are highly acceptable to domestic livestock. Both cattle and sheep are grazed throughout, but relatively few sheep are grazed on the hot desert portion of the biome.

Forage shrubs that grow on the cold desert are especially well adapted for sheep winter grazing. The general pattern, then, is late fall, winter, and spring grazing by sheep and often by cattle as well. In the northern one-third of the biome, this is generally reduced to spring and fall use because of adverse weather conditions during winter. Cattle use in the cold portion is often of a spring-summer-fall pattern.

The hot desert portion of the biome is characteristically grazed by cattle year-long. Some sheep use occurs but is limited to the winter season.

An interesting feature of the hot desert is the occasional production of an abundance of winter annuals because of favorable moisture conditions. This happens about one out of five years on the average, and permits a tremendous increase in livestock use for a brief period.

Quality of ground water varies from area to area with a dissolved solid content ranging from less than 1,000 ppm. to more than 10,000 ppm.

Environmental Influences

Domestic Livestock. The desert flora supports a variety of forage species that are highly palatable to domestic livestock. This cattle and sheep use the area extensively but relatively few sheep are grazed in the far-western portion of the Basin.

Forage species that grow on the salt desert are especially well adapted for early winter grazing. The general pattern, then, is late fall, winter, and spring grazing by sheep and winter by cattle as well. In the northern two-thirds of the Basin, this is generally reduced to spring and fall use because of adverse weather conditions during winter. Cattle use of the arid portion is often of a spring-summer-fall pattern.

The far western portion of the Basin is characteristically grazed by cattle year-long. Some sheep are grazed but are trailed out for the winter season.

An interesting feature of the salt desert is the infrequent production of an abundance of annual grasses resulting in temporarily excellent range conditions. This happens about one out of five years on the average, and permits a temporary increase in livestock use for a brief period.

While forage in the cold desert is especially well adapted to sheep use, sheep numbers have declined drastically over the years because of economic considerations. Conversely, cattle numbers have increased.

Initially of domestic origin, bands of wild horses and wild burros now roam a number of ranges of the Hot Desert uplands and remote areas of the Cold Desert. These animals are protected by law, but in some localized areas have seriously depleted desert vegetation.

Minerals. Mineral deposits, both leasables and locatables, are found fairly well distributed throughout the desert biome. Leasables are principally of the evaporite type (salts) with the exception of sulfur which was possibly introduced as a result of the volcanic activity in the biome. Locatables are generally of the fissure filling, veing replacement, or disseminated in the rock as porphyry type deposits.

Both leasable and locatable mineral deposits are found throughout the Desert Biome. Major areas of concentration appear to be in the areas of the major faulting and volcanic activity. These are in areas unlikely to produce oil and/or gas.

Evaporites are likely to be found where the downthrown block of a fault has exposed lower-lying former lake beds, the drying up of which has resulted in formation of bedded deposits of evaporites.

Locatables are likely to be found in the areas of major faulting, primarily where the faulting is complex and of the reverse, thrust, and strike-slip type with a reasonably large amount of cross faulting. Areas having normal faulting do not appear to be as likely to contain ore deposits.

Leasable minerals likely to be found in the desert biome are phosphate, sulfur, gypsum, salt, potash, borates, lithium, bromine, manesite, and brucite. Examples of locatable minerals to be found are barite, fluorspar, manganese, molybdenum, vanadium, tin, tungsten, niobium, tantalum, gold, silver, copper, lead, and iron.

Human Settlement and Use.

Population settlement patterns in the biome tend to be extremely light in density for a majority of the area. Most counties in 1970 had a density of less than 10 persons per square mile compared to a national average of 57.5. Exceptions to this are regional market centers and those areas which have developed intensive agriculture through irrigation. Population concentrations occur in the vicinity of El Paso, Texas; Phoenix-Tucson, Arizona; Southern California; Las Vegas, Nevada; Reno, Nevada; and in a linear corridor from Boise, Idaho to Salt Lake City, Utah.

In spite of very low population densities, most of the biome experienced a net population gain during the 1960-1970 period.

Very sparsely populated areas of Nevada and Arizona, for instance, experienced a gain of 13.3% or over in 1960-1970.

The entire area is dependent upon a limited water resource. Principal industries in rural portions of the biome are agriculture and mining. Urban centers tend to be new, very modern, with growing manufacturing and service-oriented industries. The Reno - Las Vegas areas have expanded entertainment and tourist services into a major industry.

One of the reasons for significant population and economic growth in the biome during recent years has been its "amenity" resource. Warm and typically cloudless weather, low population, and a ready access to recreation, open space lands, add up to a high wuality natural environment. Tourism and recreation are growing rapidly. Subdivision and sale of lands for retirement or recreational use is mushrooming in many rural areas. In urban areas, the "quality environment," in combination with ready access to services, educational institutions, and a labor market, form a magnet for industries not constrained by ties to raw material sources or national market centers. Typical of these are apparel, electronics, or aircraft manufacturing.

Very sparsely populated areas of Nevada and Arizona, for instance, experienced a rate of [illegible] or more in 1960-1970.

The [illegible] area of employment growth [illegible] service occupations. [illegible]

One of the reasons for significant population and economic growth in the Black Belt, [illegible] the "Sunbelt" phenomenon. [illegible]

Land Uses.

Agriculture. Native vegetation covers a major portion of the area and is used for livestock grazing which is the principal agricultural activity in the biome (on an area basis). Livestock operations include both cattle and sheep grazing. The former are primarily cow-calf operations while the latter are oriented towards lamb production. The bulk of these lands are also in some form of public ownership. Extensive areas are used for military operations or other government purposes, such as Atomic Energy Commission test grounds. Livestock grazing is permitted in such areas on a limited basis.

Natural vegetative productivity for grazing decreases, generally, from north to south in the biome. Areas in the hot desert become marginal, and in some cases, unsuitable for livestock use.

Limited areas physically suited for irrigation have been the key factor in determining the extent of irrigated portions. Vast areas of productive soils, but lacking water, exist in a native condition. Important irrigated crops in the cold desert are potatoes, sugar beets, grains, and hay. Warmer climate in the hot desert allows the growing of subtropical fruits, cotton, and specialty crops.

Wilderness. Areas formally designated and managed as wilderness, primitive or roadless, are very limited to date in the biome. However, areas exist which have the potential, and presumably will be considered

Land Use

Rangeland. Native vegetation covers a major portion of the area and is used for livestock grazing which is the principal agricultural activity in the basin [illegible]. Livestock operations include both cattle and sheep ranching. The cattle are primarily cow-calf operations while the sheep are operated mainly for lamb production. [illegible] of these herds are able to make use of public rangeland. Rangeland areas are used for wildlife habitat or other recreational purposes, such as [illegible]. Livestock grazing is permitted in some areas on a limited basis.

[illegible]

[illegible]

[illegible]

for use in one of the above categories as land use planning progresses. Such areas exhibit native vegetative cover, are large in size (over 50,000 acres), and lack any significant development such as roads, buildings, or other facilities.

Mining. Minerals and mining were a key factor in the original development of much of the biome. Gold and silver booms were in many cases the thrust for initial settlement. Current mining or potentials of significance are coal, oil shale, and phosphates in the eastern portion of the cold desert and copper in the hot desert (Phoenix-Tucson area). Other minor metallic mineral operations occur throughout the biome. Potential geothermal steam sources for power generation are being explored in such areas as the Imperial Valley on the Mojave Desert.

Current production of oil and gas is limited in the Desert Biome, occurring along the eastern portions of the desert in Wyoming, Utah, Colorado, and New Mexico.

Recreation. Extensive recreation uses occur throughout the biome. Pressures for use increase nearer large population concentrations. The western portion of the hot desert, which is adjacent to the Los Angeles - Las Vegas - Phoenix urban areas is receiving extremely high use by the general public. Open space such as this represents a valuable recreation resource.

Surface water is very limited. Where it does occur, it is used heavily for the more intensive forms of water-based recreation activities.

Urban. Urban land uses are separated by vast areas of open space. Settlements outside metropolitan areas tend to be small with populations of less than 10,000 persons. Settlements which serve a local market area or those which are developing a tourism-recreation industry will probably experience an increased demand for residential, commercial, and industrial land uses.

It appears that large scale demand for recreational or retirement homesites will continue to expand in remote areas.

Metropolitan areas have experienced phenomenal growth recently. The Las Vegas urban area, in 1970, had a population of 229,500 with a growth rate of 165% over the decade. The urbanized area increased from 35 square miles to 121 during this period. Other metro areas such as Phoenix and Salt Lake City experienced similar growth. There appears to be no reason why the extraordinary growth of metro areas should not continue in the future. Large areas of adjacent rural land will be required for expansion.

Aesthetic Values.

The term "desert" for many people carries with it a connotation of sand dunes and desolation. While it is somewhat inhospitable for

man, the connotation is far from accurate. It may, however, be responsible, in part at least, for the lack of development and use of the desert in the past. People are just now discovering the desert for the wide variety of interests it really has. There are sand dunes in both the cold and hot deserts, but the total area involved is a very minor part of the area as a whole. The dunes just provide one more interesting facet to the variety that people are finding more and more enjoyable.

Although there are many similar characteristics throughout, the desert biome can be more clearly described in the two separate sections.

Cold Desert. The land form of the Cold Desert is typically the flat dry bed of an ancient lake or the relatively low rolling hills of the Great Basin, occasionally interrupted by a small mountain range. Seldom is the observer out of sight of a mountain somewhere in the area of view. Texture of the Cold Desert is generally the relatively soft texture of the vast expanses of sagebrush broken occasionally by a bare ridgeline, a steep gully, or a flat dry lakebed. Color is not an important factor in the cold desert. It is generally dominated by the gray-green of sagebrush or the flat grays and browns of the soil typical to the region. Soil color becomes a more important factor in some portions of the cold desert in Wyoming and Colorado where the red sandstones make up the parent material.

[illegible], the concentration is low [illegible]. It may, however, be [illegible], in part at least, [illegible] the lack of [illegible]

Although there are many [illegible]

Soil Canopy. The [illegible]

Lines play a very minor role in the makeup of the character of the cold desert. Lines that are evident are primarily those caused by man: roads, fences, and powerlines that occasionally cross through the area. Although these intrusions are few, those that are present are very obvious for many miles.

As in the grasslands, scale is difficult to define. Vastness of open space with few vertical elements in the landscape make it hard to tell just how far an observer is from a given object.

Hot Desert. The character of the hot desert is considerably different than that of the cold desert. Form is more often remnants of eroded mesas with broad flat valley bottoms. Where there are live streams running through the desert and erosion is still very active, steep, sometimes vertical canyons are incised into once flat mesas. Prime examples of this area are the canyons of the Colorado and Snake Rivers.

There are distinct horizontal and vertical lines evident in the mesa tops and sharp drop-offs to the valley floors. Color becomes a dominant factor in the hot desert. Rich reds and browns of exposed soil and rocks are much more in evidence than in the sage-covered cold deserts.

Texture is fairly coarse because of the widely scattered vegetation. Rocks and soil are exposed over much more area.

Scale is much easier to define in the hot desert. Vertical lines created by edges of eroding mesas along with the larger and more scattered vegetation provide the observer with the elements needed to more accurately judge size and distance.

Sound and smell have almost no bearing on the description of the present environment, although introduction of either would be immediately noticeable, at least in localized areas.

Geologic Values of Human Interest.

Deserts have some of the dullest sightseeing geology and some of the most intriguing. In the basin and range areas of Nevada, it tends to be somewhat repetitive in gray with long sweeping views of the basins and short quick trips through the mountain ranges. Certain areas, particularly the Colorado Plateau, are highly eroded, mostly in color formations which produce delicate erosional features, easily recognizable "picture book" geologic structures, and grand views of the total. Scattered throughout the biome are some of the most magnificent canyons in the world, the Grand, the canyons of the Snake, the Owyhee, the Green, and others. Also present are sand dunes, volcanic features, playas, and fault structures.

Archeological Values.

In the Desert Biome are found remnants of both Big-game Hunting Tradition and Old Cordilleran Tradition cultures, the former to the

east and south and the latter more to the north and west. Big game hunters in Southeast Arizona hunted mammoths along with other big game. Peoples in the Nevada desert were mostly gatherers, but did hunt small game, including waterfowl, around the many pleistocene lakes in the region.

These two traditions developed into what is termed the Desert Culture Tradition, a basic gathering culture that existed on the many grasses, pinyons, insects, acorns, small game, and other products of the hot and cold deserts.

From this desert archaic base there developed, as the result of strong influences from the valleys of Mexico, several agricultural cultures in the hot desert and the southern portions of the cold desert. Irrigation farming was practiced, large communal structures constructed, and highly organized and structured social systems developed. At the same time period, there also were people with the desert archaic tradition still co-existing and others like the Apachean groups moving into the desert area. This was the situation at the time of first non-Indian contact (by the Spanish explorers) in the early 1500's.

Large archeological sites of the Desert Biome are quite easy to detect, but attention paid to these sites tends to allow other, less pretentious sites like agricultural terraces, campsites, chipping areas, small canals, and shallow caves to be destroyed. Particular care should

be placed in development of water sources, for in the dry desert there is always a very close relationship between archeological sites and water sources. Water sources were as important to prehistoric man as for modern man.

There are also large rock alignment figures called "intaglios" which occur along the Lower Colorado River. They are difficult to see from the ground and just driving over them tends to obliterate them.

Historical Values.

Like much of the west, history of the Desert Biome is generally so recent that some individuals still living there have seen 90% of the important historical events that have taken place. Most of the settlement has taken place in the last 100 years. Only in southern parts of the hot desert is civilization older due to the Spanish and Mexican settlement. The Great Basin portion of the cold desert is the least inhabited area in the country with history revolving around mining ghost towns and the ranching industry. In the hot desert, irrigation agriculture has been a way of life from prehistoric times. Other than these local influences, historical values are similar to those of the Grasslands.

Cultural, Ethnic, and Religious Values.

There are some interesting cultural-ethnic and religious groups in the Desert Biome. In Nevada are groups of Basques originally

brought to this country as sheepherders from the Pyrenee Mountains of Spain and Portugal. In Utah, Arizona, and Nevada are the Mormons, a religious group who are a minority in the United States but a majority group in the Desert Biome. Another group are the Yaquis living near Tucson. Although native Americans, they are living here as a political refugee group from Mexico.

There are a great number of native Indian Americans living on the reservations in the Biome, too. These range from farmers like the Pimas and Papagos to hunting-gathering peoples like the Uavapai and Paiutes. All of these groups have a strong attachment to the lands which surround their areas of settlement.

Unique Management Problems.

The very nature of the arid climate, sparse vegetative cover, and erosive soils, resulting in a delicate ecosystem, requires very careful intensive livestock grazing management. Aquatic habitats are extremely important in this biome for a wide variety of uses as well as "home" for several rare and endangered species. Wild horses and burros are found principally in this biome and require special consideration under this proposed intensive grazing program. The biome is rich in archeological and aesthetic values which must be preserved.

Socio-Economic Factors.

The cold Desert Biome contains the largest land area in the 11 Western States with over 240 million acres (Table 4). In

addition, the BLM administers the highest percentage of this biome with 40.3 percent or 97 million acres. On the other hand, this area has the lowest population density with 7.46 persons per square mile. Total employment is nearly a million persons who produce nearly 7.5 billion dollars in personal income.

Agricultural employment is 6.9 percent of the total employment. Total agricultural sales is $1.3 billion of which 44.5 percent is cattle sales. The BLM contributes 12.86 percent of the 58.6 million AUMs produced in 1970. Thus, it may be seen that BLM grazing is quite important to the economy of the Cold Desert Biome. In fact, in some areas of Nevada and Utah, cattle sales exceed 70 percent of total agricultural sales and BLM grazing contributes 40 percent or more of the forage.

The Hot Desert Biome exists on approximately 124 million acres. The BLM administers nearly 28 percent of this amount. The population of this area was 14 million persons. But, this includes the Los Angeles area which inflates the number considerably. The work force is in excess of 5.3 million persons who generated $51 billion of personal income.

Agricultural employment was 141 thousand persons. Total agricultural sales in the biome was $2.4 billion dollars of which 32.5 percent was cattle sales. Of the 33.3 million AUMs of livestock in the biome,

3.47 percent was provided by the BLM. In southern Nevada, the dependence is over 23 percent, but this drops below 6 percent dependence in Arizona and even less in southern California. Nevertheless, BLM range is important to the economy of some of the area.

4. Pacific Coniferous Forest Biome.

The northwest coniferous forest includes western Washington and Oregon extending into northern California and southern Alaska. It is one of the more important timber-producing areas in the world. This region, although logically included in the Coniferous Forest Biome, is discussed separately in this report because its physiography, climate, ecology, and socio-economic importance is distinctly different from other regions of the Coniferous Forest Biome.

Much of the national resource lands in this area reverted to public ownership, administered by BLM, when the Oregon and California Railroad grant terms were violated. These lands, and additional tracts managed by BLM, support valuable stands of commercial timber and are interspersed with State, other Federal, and private holdings. The checkerboard land pattern, extremely high timber values, and significance of this timber to local economies make these national resource lands extremely important.

Topography

Elevations range generally from 500 feet to about 4,500 feet above sea level. Topography is steep mountainous uplands with very narrow, deeply entrenched valleys. Along the crest of the Cascade Mountains, volcanic cones are distinctive surface features. Some low mountains and foothills with smooth moderate slopes, and bottom

lands, terraces, and fans with nearly level to gentle slopes occur throughout the biome.

Climate

Moist Pacific air moving in a west-to-east path results in extremely high rainfall all along the coast. The dry season reaches its climax in July and August, after which the rainy season comes on gradually, reaching its peak in December.

Average annual precipitation ranges from 30-40 inches in the San Francisco area, 60-140 inches in the Olympia Mountains of Washington, and 80-150 inches in the south central coast section of Alaska. Heavy fog compensates for lower rainfall in the southern areas.

Temperatures range from a low of 15^{o} F below zero along the Alaska coast to 30^{o} F at San Francisco, while high temperature can reach into the 90s throughout the area. Mean daily temperatures range from 20^{o} - 35^{o} F in January to 50^{o} - 60^{o} F during July.

During winter months, wind sometimes attains hurricane force along the ocean coast. In summer months, northerly winds prevail, especially in the daytime. Thunderstorms are infrequent and usually feeble along the western part of the area.

Vegetation

The identifying life form of this biome is the needle-leafed evergreen tree, especially spruces, firs, and pines. Coastal forests, lands, however, and [illegible] fully nearly level to gentle slopes occur throughout the Animas.

Climate

Winter [illegible] are marked by a snow-blanket which results in increased [illegible] [illegible] moisture. The dry summer reaches its climax in July and August, during which the heavy seasonal rains [illegible] gradually, [illegible] the peak in September.

Average annual precipitation ranges from 10-12 inches in the [illegible] [illegible] [illegible] inches in the [illegible] [illegible] of [illegible], and [illegible] inches in the [illegible] [illegible] [illegible] [illegible] [illegible] in the [illegible] [illegible] and [illegible] in the [illegible] [illegible].

Temperatures range from a low of -20° F during [illegible] [illegible] to [illegible] in July [illegible] [illegible] [illegible] [illegible] [illegible] in [illegible] [illegible] [illegible] [illegible] temperatures range from [illegible] - [illegible] F in [illegible] [illegible] - [illegible] F during [illegible].

During [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] along the [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] in the [illegible]. [illegible] and [illegible] [illegible] the [illegible] part of the area.

[illegible]

The [illegible] [illegible] of [illegible] in [illegible] [illegible] [illegible], [illegible] [illegible] [illegible], [illegible], and [illegible]. [illegible] [illegible], although dominated by the conifer life form, are quite different ecologically and floristically from the Montane forests.

Western hemlock, western arborvitae, grand fir, and douglas fir are the big four among the dominant trees. Southward, redwoods are found, and northward, sitka spruce is common. In this biome, a dense shade exists year around, often resulting in poor development of understory shrub and herb layers. However, the continuous blanket of chlorophyll present the year around results in a fairly high annual production rate.

Coniferous forests are among the great lumber producing regions of the world. Production of lumber per unit area is potentially very great if the harvest-regeneration and nutrient cycles can be maintained. As with all ecosystems in which a large percentage of nutrients may be tied up in the biomass, there is great danger that over-exploitation may reduce further productivity.

In addition to the actions of man, natural forces in the form of bark beetles, defoliating insects, disease and fire, exact annual losses to the vegetation. However, such outbreaks are part of a continuous cycle of development to which the coniferous forest ecosystem is adapted through rapid plant establishment and succession.

Soils

Inceptisols and Ultisols, normally found in cool wet climates at higher elevations receiving large amounts of precipitation, occur

in northeastern California and Western Oregon and Washington. Soil materials include sedimentary and basic igneous bedrock in the low mountains and foothills; and alluvium on fans, terraces, and bottom lands. In some places, soil is derived from pumice and volcanic ash. Soils are relatively infertile and of poor quality because of high acidity and leaching of soil minerals.

Coniferous needles decay slowly and the soil develops a characteristic podzol profile. The soil may contain a fair population of small organisms but comparatively few larger ones.

Wildlife

Some of the same species of animals found in the Rocky Mountain Coniferous Forest Biome are found also in this biome. Principal mammals are related to Rocky Mountain species. Roosevelt elk and black-tailed deer are characteristic of this forest, as is the smaller mountain beaver. Douglas gray squirrel, coast mole, and fan-tailed pigeon are typical residents. Aquatic ecosystems are diverse and complex.

West coast and Alaska streams produce anadromous steelhead and five commercially important species of salmon: the chinook, sockeye, chum, pink, and coho. Migratory populations of coastal cutthroat trout are present in many coastal streams from California to Bristol Bay, Alaska. The anadromous fisheries are unique and directly dependent

on the forest watershed. Endangered species that have been identified are the Olympic Mudminnow (Washington) and the little Kern Goldentrout (California).

Water

For a discussion of water resources, refer to the Rocky Mountain Coniferous Forest Biome discussed earlier.

Environmental Influences

See previous discussion of Rocky Mountain Coniferous Forest Biome for discussions concerning minerals, grazing, and aesthetics.

Human Settlement and Land Use

Although most portions are rough and mountainous, the coastal subbiome is extremely productive for forestry purposes. So much so, that lumbering and wood products industries play a dominant role in income and employment throughout the area.

The Seattle and Portland metropolitan areas are located in a broad valley extending from Puget Sound to central western Oregon. The same valley also contains the bulk of intensive agricultural land within the region. Dairying is a major agricultural use. Low cost hydroelectric power, abundant water resources, and deepwater ports have contributed to industrial growth of urban areas.

Forested lands and abundant wildlife and fish resources provide very significant recreation potentials. Close proximity to the

Pacific Ocean adds to the recreational diversity. Climate, however, which includes long periods of rain or fog, is a limiting factor for year-around use.

Typical settlements such as those outside of the Puget Sound or the Willamette Valley are small and center around lumbering or sawmilling.

Except for limited urban areas, such as Valdez and Juneau, settlement in the southeastern Alaska portion is much less developed than that of the lower 48.

Geological Human Interest Values

The Pacific Coastal Coniferous Forest is edged with an interesting eroded coast line of natural arches, isolated rock islands, sand dunes, and steep cliffs. Higher sections contain canyons, volcanic features, caves and faulting evidence.

Archeological Values

The Pacific Coastal forest was the home of the salmon-fishing oriented Northwest Coastal Cultures. Based on the Old Cordilleran Tradition and the Northwest Coastal Tradition, it quickly evolved to become very distinctive with its great use of wood and elaborate art work. Village sites were along the streams and consisted of either pit or surface houses. Occasional rock shelters and some camp sites away from the streams are found.

readily accessible to the recreational visitor. Climate, however, which includes long periods of rain or snow is a limiting factor for water-oriented use.

Current [illegible] of the forest found on the [illegible] without [illegible] or [illegible].

Except for limited urban areas, such as [illegible] and [illegible], settlement in the archipelago's inland portion is much less developed than that of the lower 48.

[illegible] Interest Value

In general, [illegible] forest is mixed with an interesting [illegible] of natural forms, [illegible] rock islands, [illegible]. Higher [illegible] mountain [illegible], [illegible] and [illegible] glaciers.

[illegible]

The [illegible] the [illegible]. Based on the [illegible] and the [illegible] [illegible] from the [illegible].

Historical Values

In the Pacific Coastal Forest history revolves primarily around the lumbering industry and mining. Fishing and maritime activities are also an important part of the past of the region. Russian and British trading activities in the area and the latter American inroads are important facets in the late 18th and early 19th century history.

Cultural, Ethnic and Religious Values

There are only a few groups of Indians living in the coastal coniferous forest.

Unique Management Problems

Timber production, watersheds, and anadromous fisheries are among the three highest resource values and uses in this biome. Although livestock grazing is relatively unimportant, intensive grazing management must be designed to account for these other important values and uses.

Socio - Economic Factors

The Pacific Coniferous Forest Biome exists over nearly 12 million acres of which only 3.7 percent is administered by the BLM (Table 4). Just over one million people live in this biome. Of these, 351 thousand persons are employed and generated 3.5 billion dollars of personal income in 1970.

Agricultural employment was 18.5 thousand in 1970 which is 5.2 percent of the total. Agricultural sales generated by these people was just over $307 million. Cattle sales were nearly 10 percent of total agricultural sales. Of the 4.3 million AUMs of forage used in 1970, 12,323 AUMs were derived from BLM lands. This is only three-tenths of a percent of the total. Thus, it is evident that the BLM contribution to the economy of this biome is quite low.

5. Woodland - Bushland Biome

Three basic component communities of this biome are:

A. Broad Sclerophyll - (Oak, chaparral)

Extends from central Oregon through California, and usually receives considerable rainfall in winter and a long dry period in summer. Three vegetation types with accompanying biota are recognized: broad sclerophyll forest (large oaks with a grass cover); other woodland-grass; and chaparral.

B. Oak Woodlands, Bushlands

The woodland includes the lower altitudes of Arizona. The bushland occurs in the Rocky Mountains and merges into the woodland in Arizona. It occurs below pinyon-juniper over the eastern two-thirds of the latter's range.

C. Pinyon-Juniper

These include an estimated 60 million acres in the western juniper-buckbrush region of northeastern California, northwestern Nevada, and south Oregon; the Great Basin, and the Rocky Mountain plateaus between northern Wyoming and central Arizona and New Mexico; and the oak-juniper region in eastern Arizona, New Mexico, and west Texas.

The Woodland-Bushland Biome is wide spreading in the western United States, but discontinuous, occurring as biological islands at the

higher elevations within the Grassland and Desert Biomes. Also, it forms a transitional zone between these biomes and the Rocky Mountain Coniferous Forest Biome. In many ways its vegetative characteristics are similar to the Cold Desert.

Because of the diversity and widespread nature of this biome, some discussion of ecological interrelationships are appropriate.

Most of the vegetation is woody trees or shrubs resulting in storage of nutrients and slow cyclic action. Nitrogen is believed to be a limiting factor in productivity. At higher elevations the interrelationships resemble the forests with rapid energy turnover and a greater lag of autotrophic production.

The woodland-bushland community generally occurs on unstable areas in relation to soils and physiographic features. Disturbance to the vegetation often results in extensive erosion and subsequent establishment of desert type communities, even at higher elevations.

The aquatic ecosystem in the woodland-bushland biome occurs primarily in rivers and perennial and intermediate streams generally originating in higher elevations on forests. Soil characteristics accompanied by occurrence of high intensity storms result in heavy siltation. Surface disturbance accelerates siltation. Information regarding the aquatic ecosystem and the microbial ecology of the brushland is scarce and should be more adequately defined.

The woodland community ecosystems, because of past history of overuse and relationship to other associated communities, are still in the transition stage. There is sufficient evidence to indicate that woodland communities, especially pinyon-juniper, have extended themselves into former grasslands and sagebrush sites. This trend is still in evidence and it is expected to continue until surface management practices come into balance with climatic, site, and environmental factors.

There is a close relationship between the woodland ecosystem and fire. Under a natural system, fire was probably a major factor in maintaining a balance between the woodland and adjacent plant communities. Modern efforts in fire protection have significantly contributed to the expansion of sclerophyll and pinyon-juniper woodlands.

California chaparral has been described as an example of a catastrophic climax vegetation. Vegetation in this area, combined with hot dry summers, presents a recurring and extreme fire hazard. Fire removes the shrubby vegetation and the antibiotics it produces. Herbaceous vegetation develops rapidly and occupies the site until shrub dominance is re-established. However, removal of the existing heavily dominant shrub ecosystem by fire or other disturbance can result in disastrous floods and extensive siltation.

Topography

Most of the woodland-bushlands are located on the high hills and mountains of the desert where the soils have a slightly higher organic content. Annual precipitation is higher than in the intermediate desert valleys.

One of the major physiographic features results from the tetonics or faults within the region. Many extensive known faults occur within, adjacent to, and pass through this biome. The pronounced San Andreas fault zone is a major strike slip fault along the California coast; several portions or branches of this fault have created surface features of the western foothills of this biome. This is also an active earthquake zone with many epicenters of slight-to-major magnitude being recorded from the 1600's to the present.

Climate

Climatic conditions vary greatly within the Woodland-Bushland Biome. Basically, the deserts east of the Sierra Nevada Range are comparatively dry because of the mountains' "rain-shadow" effect, while the California foothills come under the influence of moisture-laden marine air.

Desert Foothills. In the northern section of the desert foothills about 75% of the annual precipitation falls during winter months. In the southern area of the desert foothills, precipitation is

somewhat even throughout the year with months of July and August being dominant rainy months. Average annual precipitation ranges from 10 to 20 inches. Temperatures range from 20° F below zero to 100° F above, with the mean daily temperatures varying from 20° F in January to 85° F in July.

Windiness, especially in the spring, is characteristic of the desert foothills. Dust devils are frequently seen on hot days along with summer thunderstorms. Local winds of 40 mph are not uncommon. The topography generally precludes fog conditions from taking place except in isolated areas (small basins).

California Foothills. Winter storms bring most of the annual precipitation with the months of June, July, August, and September remaining dry. Average annual precipitation ranges from 20 to 40 inches in the north and 10 to 20 inches in the southern part of the area.

Temperatures range from 5° F to 112° F with the mean daily temperatures varying from 45° F in January to 70° F in July.

Winds are generally light and from the south during winter months except during the passage of storms when winds frequently exceed 30 mph. During the summer, winds are out of the northwest at about 5 mph.

Fog occurs only during winter months and then only in small foothill valleys where air becomes trapped by topography. Thunderstorms occur only about five days out of every year, generally in the late spring or early fall.

The main body of brushland lies in zones of Mediterranean climate having relatively mild, wet winters and long, hot, dry summers.

Vegetation

The woodland-brushland community will be discussed by three general categories:

1. Broad sclerophyll
2. Oak Woodland and Bushland
3. Pinyon-Juniper

Broad Sclerophyll (Oak-Chaparral). In the mild temperate region from central Oregon through California, vegetation generally consists of trees or shrubs with hard, thick evergreen leaves. Three life forms, Sclerophyll forest, woodland, and chaparral merge with one another without distinct regions and little or no successional relationship. All are best developed on the coastal ranges of southern California but their ranges extend from southern Oregon southward through the coastal mountains as well as through the Sierra Nevada foothills into lower California and into southern Utah and northern Arizona.

Chaparral is found in alternating patches in most parts and occupies the greatest area. In California some five to six million acres of slopes and canyons are covered with chaparral. The vegetation combined with hot, dry summers, presents a recurring and extreme fire hazard.

The Sclerophyll forest generally occurs on the more highly developed north slope sites. Scattered trees or woodland types occur with an understory of grass, chaparral, or sagebrush. The woodland-grass type surrounds the California grassland, extends northeast along the Coast range and occurs in other scattered areas.

The greatest value of the broad sclerophyll to man is for watershed protection. Chaparral, for example, consists of shrubs which form dense canopy thickets with little or no understory vegetation. It occurs on steep, loosely consolidated slopes which are highly erosive. Removal of the vegetation by fire or other means can result in disastrous floods propelled into thickly populated lowlands. The long, dry summers result in high fire danger and fire is an important factor in the ecological development of the sclerophyll.

Oak Woodland-Bushland. Oak woodland and oak bushland vegetative types occur generally scattered as ecotones between the desert biome and the pinyon-juniper community. Geographical location of the communities is dependent upon topography and climate. The oak

bushland community is found in the Rocky Mountain foothills and the interior ranges in Utah and Arizona at elevations between 5,000 and 8,000 feet. Vegetation usually does not form a continuous cover but occurs in dense clumps, some of which may be quite large. In addition to oak, vegetation generally consists of deciduous shrubs of numerous species, the composition of which is dependent upon elevation, diverse topography, and aspect. The number of plant dominants is large with several species appearing regularly in each community.

The oak woodland community occurs generally in southern Arizona and New Mexico. In addition to oak, juniper, small trees, undershrubs and grasses are interspersed. This community is also somewhat scattered and understory vegetation varies from cacti and yucca to grasses and shrubs. Topography is usually steep-to-rolling and soils are generally erosive.

Pinyon-Juniper Woodland. Pinyon-juniper communities cover an area of approximately 60 million acres interspersed generally through the cold desert biome in the western United States. A majority of the type occurs in the five states of Nevada, Utah, Colorado, Arizona and New Mexico.

Pinyon-juniper generally occurs at elevations between 5,000 - 7,000 feet. Stand density varies from a very few trees per acre to 600 or more per acre. A rather open stand is typical but areas

of dense trees are not uncommon. Very often the stand thickens progressively from scattered trees at lower elevations. Maximum density occurs just before the rapid transition is made into timber or mountain shrub types. The lower, sparse portion frequently consists of juniper reproduction on sagebrush or desert grass sites. Pinyon pine generally becomes established following juniper establishment. Since junipers are more drought resistant they are commonly found at elevations 500 feet lower than pinyon. Broad areas with savannah characteristics occur primarily in New Mexico and Arizona where the understory is composed of mixed desert grasses and shrubs.

The herbaceous undercover varies inversely with the tree and shrub density. However, it was observed in Arizona that shrubs may tend to increase with the number of trees until a tree density of 50% is reached. The shrub undercover then decreased sharply where tree canopy exceeds 60% ground cover.

Plant production under natural conditions is greatest in the southern portion (Arizona and New Mexico) of the pinyon-juniper type. This is true of both trees and understory. Trees will grow to 40 feet on the better sites in the south, while 30 feet is about maximum in the northern areas.

The flora of different physiographic areas of the pinyon-juniper type are conditioned by climatic and other factors encountered. Prominent plant species and associations vary accordingly.

Soils

Soils of the woodland surrounding the San Joaquin Valley are predominantly of the Aridisol order with warm-dry surfaces, while the soils of the foothills along the west coast are of either the Entisol or Mollisol order but also have warm-dry surfaces. Soil characteristics, steep topography, and high intensity summer storms result in heavy siltation of some of the aquatic ecosystems. Surface disturbance accelerates siltation.

For a more detailed description of the soils of other plant communities in this biome, refer to the description of the Desert Biome.

Wildlife

Terrestrial.

In this biome, wildlife can best be grouped as inhabitants of the pinyon-juniper, the interior oak woodland, and the coastal (California) chaparral. Few animals are restricted to the *pinyon-juniper zone* although many are typical of it. Pinyon jay and gray titmouse birds are characteristic permanent residents largely restricted to this biome. The whiteheaded woodpecker winters in the pinyon-juniper.

In the Kaibab-Zion area, mule deer is dominant in winter. The mountain lion is the chief predator along with the coyote and bobcat. Desert wood rat and rock ground squirrel are characteristic residents. The nocturnal pinyon mouse is perhaps the most abundant mammal found throughout the woodland. The cliff chipmunk, black-tailed jack rabbit, and Nuttall's cotton-tail are common residents. Nesting birds include the golden eagle, red-tailed hawk, and scrub jay.

There is a comparatively small number of reptiles in the pinyon-juniper; they are most common at lowest elevations. Reptiles include the sagebrush swift, several lizards and snakes, including rattlesnake and kingsnake.

In New Mexico the Mexican wood rat reaches its greatest abundance. In the Big Bend area of Texas typical animals include the white-tailed deer, gray fox, brush mouse, several lizards, and the rock rattlesnake.

More mammals occur in the oak-juniper of southern Arizona and New Mexico than in the pinyon-juniper zone. These include the ringtail, white-tailed deer, fox squirrel, turkey, bobwhite, and mourning dove. Forty-two permanent resident birds, at least 16 species of lizards, and as many snakes have been listed.

In the Rocky Mountain bushland most vertebrate animals are either transitory or seasonal. Mule deer is an important dominant along with the usual large predators. Long-tailed weasel, spotted, and Great Basin skunks are common. Most rodents remain active. Hibernating mammals include the jumping mouse, marmot, Uinta, and golden mantled ground squirrels. There are many birds including winter visitors. Large mixed flocks of birds winter in canyon bottoms or other sheltered locations. Of eleven reptiles, only the rubber boa appears to belong primarily to the bushland.

In the sclerophyll bushland or chaparral in California and southern Oregon, mule deer of several subspecies are wide ranging. Typical mammals include the mountain lion, bobcat, coyote, gray fox, wood rat, skunk, and brush rabbit. Merriam chipmunk, California mouse, and five-toed kangaroo rats are confined to chaparral. There are numerous small birds and lizards; but except for the tree frog, amphibians are absent.

Aquatic. Aquatic wildlife forms are characterized by representatives of both cold- and warm-water fish species. A variety of aquatic environment exists in small, sometimes intermittent, streams; upper reaches of larger rivers; impoundments; and some natural lakes.

Waters are moderately rich in nutrients and micro-organisms and water quality may be fair to good. Some streams may carry heavy silt at times in brushland areas with the better quality and more

stable waters in wooded areas. Fish species diversity is limited. Representative fish are salmonids (trout), whitefish, catfish, suckers, carp, squawfish, shiners, minnows, dace, chubs, sculpins, sunfish, perches, basses, and pikes.

Endangered Species. There are no known threatened species of mammal, bird, or fish unique to this biome. There are some rare species which range into it, such as: spotted bat, Utah prairie dog, San Joaquin Kit fox, blunt-nosed leopard lizard, Colorado River squawfish, the humpback chub, and sucker.

Water

There is a wide range of water resources within the woodland-bushland biome. As found in the grassland and desert biomes, most of the water is supplied by rivers and streams with headwaters in the high elevation forests above the woodland-bushland areas. These higher elevations provide most of the surface waters for this biome.

The woodland-bushland areas generally receive from 12 inches to 25 inches of annual precipitation with extremes of up to 50 inches in the California oak-chaparral area. Both ephemeral and perennial streams are found in the woodland-bushland areas. Flood waters of ephemeral streams which are typical of the juniper areas are generally heavy-laden with silt. High intensity summer thunderstorms are typical of the juniper areas and flood runoffs are not uncommon there. Both quantity and quality of surface and ground water varies from area to area within the woodland-bushland communities.

This biome generally occurs on high flood hazard areas because of the nature of the storms and the physiography. Disturbance of the vegetation often results in extensive erosion and the open parklike nature of the pinyon-juniper, with little understory vegetation, leaves the soil exposed to water erosion. Water runoff is generally high in soluble salts. The greatest value to man, of the chaparral slopes, lies in watershed protection. Not only do the steep, loosely consolidated slopes erode easily, but disastrous floods are propelled into the thickly populated lowlands if the chaparral community does not remain in a healthy condition.

Surface Water. Like those found in the grasslands and deserts, surface water resources of the woodland-bushland areas include streams, rivers, reservoirs, lakes, and springs. Uses include domestic, municipal, industrial, power, agricultural, recreation, and fish and wildlife supplies.

While the lower precipitation zones (10" to 15") yield very little annual runoff (0.1" to 0.5"), the higher precipitation zones of 15 inches to 25 inches yield important annual runoff of from 0.5 inch to more than 10 inches. For the California oak-chaparral area, annual water yield may be as high as 20 inches from a precipitation of up to 50 inches which comes mostly as rainfall during the winter months.

Quality of most surface waters within the woodland-bushland areas is generally adequate with the exception of some of the juniper area streams which are high in silt content. Average dissolved solids (ions of sodium, calcium, chloride, etc.) range from less than 100 ppm (parts per million) to more than 2,000 ppm. Average sediment concentration of streamflow varies from less than 280 ppm in oak woodlands to more than 30,000 ppm in some juniper-associated areas.

Ground Water. Ground water supplies of the woodland-bushland areas vary from area to area as in the grasslands and deserts. Good quantities of ground water are found in some areas such as those of the alluvial basins of California, Nevada, and Arizona. Ground water of the woodland-bushland areas is used for such purposes as irrigation, domestic, municipal, and stock-watering supplies.

Ground water quality varies from area to area but is generally good with a dissolved solid (ions of sodium, calcium, chlorides, etc.) content that is normally less than 1,000 ppm.

Environmental Influences

Domestic Livestock. Location of the Woodland Biome at the upper elevational margin of the Desert Biome and interspersed throughout it as biological islands, results in livestock distribution and use similar to that of the Desert Biome. In general, the pinyon-juniper portion serves as spring and fall range for both sheep

and cattle and as summer range for cattle in some areas. Some winter sheep use occurs in the southern half as well as some year-long cattle use. Horse use is minor, although portions of some of the established Wildhorse Ranges are located in this biome.

Forage species in the California portion (chaparral and oak woodland) are largely winter annuals. Therefore, grazing use occurs for the most part during winter and early spring when forage is at its best.

Cattle have been on the increase and sheep have declined over the years. After declining drastically, horses have reached a point of relative stability.

In general, ranches are cow-calf operations or produce lambs. In the California woodlands, the practice of running steers or yearlings is not uncommon because of the seasonal nature of the forage. The open stands of dwarf trees provide ample light to the soils but insufficient moisture and dominance of the trees produces little understory vegetation. However, where grasses, forbs, and shrubs are present, this type provides extremely valuable habitat for deer and grazing for domestic livestock.

Minerals. In the major portion of the Woodland-Bushland Biome, minerals are the same as those occurring at immediately lower

elevations on the desert. Outside the desert area, most of the Woodland-Bushland Biome is in California. Here, leasables are generally of the evaporite bedded types, with most of them being near the biome boundary bordering the California prairie grasslands. They are primarily in the sediments. The minor coal is low-volatile bituminous and also some lignite. Leasables on the western side of San Joaquin Valley in the marine sediments are in areas which could be considered valuable for oil and gas. Locatable minerals are found both as vein and bedded deposits and for the most part in the sediments on the eastern flank of the San Joaquin Valley. The deposits very likely are closely associated with the Sierra batholith and also the faulting throughout this biome.

Predominant locatable minerals are gold, silver, iron, copper, tin, vanadium, chromium, manganese, barite, gypsum, magnesite, brucite. Predominant leasable minerals are sodium, iodine, borates, sulfur, phosphate, and minor coal.

Human settlement and use in this biome, with the exception of the California portion (oak-chaparral), is very similar to that described in the Desert Biome.

The California Oak-Chaparral is adjacent to, and partially includes, large metropolitan areas. Population densities, therefore, vary from over 250 persons per square mile in expanding suburbs, to

less than 10 in undeveloped areas. Even the more isolated areas, which are still rural in nature, reflect the economic and social influence of nearby metropolitan areas.

Vegetation in this area, combined with periodic hot, windy and dry climatic conditions presents a recurring and extreme fire hazard to all population and land use.

Land Uses

Agricultural. Rough and steep topography limit agriculture in most areas to livestock grazing. Production of livestock is the principal land use in the biome because of this factor. Very minor portions, mainly in narrow valleys, are irrigated and intensively farmed. Ranches tend to be isolated.

Recreational. The biome supports many extensive recreational uses. Big game and upland game birds provide hunting opportunity in most areas. Areas near population concentrations now receive heavy recreational use which is expected to increase in the future.

Mining. As in the Desert Biome, many areas have had a past history of metallic mining (such as gold in the California Mother-Lode Country) which has since decreased in significance. Areas within Colorado, Utah, and New Mexico have produced oil and gas and potentials may be relatively high. The western side of the San Joaquin Valley of California also has some valuable oil and gas-bearing formations with a number of currently producing wells.

Wilderness. Extensive roadless or undeveloped areas exist with primitive qualities. Streams within these areas may meet criteria for wild rivers. The California Oak-Chaparral tends to be more developed and therefore has less area with primitive or semi-primitive qualities.

Forest Products. Woodland components of the biome support a very small, but locally important, source for cord wood and fence posts. Pinyon-pine nuts are traditionally harvested by some Indian cultures in the Pinyon-juniper zones.

Urban. Small, isolated ranching or mining towns are scattered throughout the area, as is typical in the Desert Biome. Suburban expansion is occurring in California and to some extent in the Salt Lake City area. In California, fire hazard and suburban development present a major problem.

Aesthetics

The Woodland-Bushland visual environment is one that varies greatly. It ranges from a semi-desert to a wooded foothills landscape.

Since valley bottoms in the west are also principal travel routes, much of the woodland-bushland type is exposed to view of the traveling public. In some areas this view is from a considerable distance. In others it is directly adjacent to the travel route.

Land form of the woodland-bushland communities varies from relatively flat valley bottoms through the low-rolling foothills to deep-cut canyons and high mesas. Most typical of these would be the rolling foothill area.

Texture varies as the density of the stands vary, from a continuous dense canopy to an open, scattered random pattern.

Color varies almost as much as land form and texture. Where there is a fairly continuous canopy, the gray-green of the vegetation is predominant. As the stands thin, color of the soil or rocks become dominant.

Lines are only evident where there is an abrupt change in the vegetation type or where there has been some disruption of the vegetation, i.e., roads, power lines, chaining, etc. Scale is more easily defined and much more obvious in the woodlands than in the grasslands or desert.

Geological Human Interest Values

Most geological features of interest are similar to those found in the surrounding desert or grassland areas at elevations which have been previously discussed. For example, the woodland-bushlands may cover the tops of high mesas which are an integral part of the dramatically eroded areas on their flanks. In the California foothill woodland areas, there are numerous faults.

Large ones, such as the San Andreas fault passing through both prairie and woodlands, exhibit visible displacement.

Archeological Values

Prehistoric peoples who used the juniper associates and oak woodlands were, for the most part, the same ones who inhabited the hot and cold desert. Different activities tended to take place in the Woodland-Bushland Biome such as hunting or gathering of wild nuts and seeds but, one also finds agricultural areas cleared in the juniper areas so there is no clearcut division of usage.

In the Broad Sclerophyll areas of southern Oregon and California are indications of prehistoric peoples the same as in the California and Palouse Prairie Grasslands, that is an Old Cordilleran Tradition base that developed into an Archaic Tradition which continued to contact times.

Historical Values

Historically, the woodland-bushlands were probably among the last areas to be settled because of the difficulty of converting them to agriculture. Heavy brush and the lack of water made the biome less valuable for agriculture, and grazing was the predominant use in most cases. Consequently, most of the historic events that took place in the woodland-bushland tended to be trail, battle, and scuffle, rather than settlement oriented.

The Broad Sclerophylls in California cover the "Mother Lode" country of the 1849 gold rush. The area is rich in lore, replete with old ghost towns, and remains of mining activities such as dredging piles and huge hydraulic cut banks.

Cultural, Ethnic, and Religious

This Biome is intertwined with an extension of the cultures found in parts of the Grassland and Desert Biomes.

Of more unique significance, brushlands and wooded foothills of the southwestern portion of the California Central Valley lie along the route of the Spanish Roman Catholic Missionaries of the 18th Century. Many missions have been restored to their 19th Century condition along El Camino Real, while other sites remain as interesting ruins of more historical than cultural or religious significance.

Unique Management Problems

Probably of primary significance in this biome is the critical importance of the watershed. Soils are generally erosive, topography is steep, and the nature of thunderstorms result in siltation of aquatic habitat particularly in the pinyon-juniper portion. Disturbance by fire or mechanical means in the chaparral may result in disastrous downslope floods.

Urban expansion onto the steep chaparral slopes and the high fire hazard of the vegetation poses serious problems.

Wild horses and burros are found in this biome and should be considered in implementation of the intensive management proposal. Preservation of the historical and scenic values is important.

Socio - Economic Factors

Since the Brushland Biome is intermingled with most of the other biomes, it was not possible to sort out the socio-economic factors to relate to this biome. Therefore, the factors affecting this biome are included with those of other biomes.

6. Tundra Biome

This biome encompasses all of the area north and west of the central coniferous forests (Taiga) in Alaska. Basically, this treeless zone includes the Brooks Range and flatlands to the north, as well as the Seward Peninsula to the Aleutian Island chain.

While virtually all of the tundra region of northern Alaska is currently in Federal ownership, State land selections, especially in oil reserve areas, and native claims surrounding coastal settlements are likely to change this pattern somewhat over the next two decades. Oil and gas reserves are large in portions of this region. Exploration activities have been heavy in recent years. However, environmental problems on field development and pipeline construction have delayed production to date.

Because of the unique nature of this biome, a discussion of some ecological relationships is appropriate.

Temperature exerts a powerful limiting effect on the tundra ecosystem and relatively few kinds of organisms have become successfully adapted. Permanently frozen subsoil restricts the medium available for producing the living components and it also restricts infiltration of water which normally recharges ground water and furnishes stream flow. A minimum of water goes through living plants and animals and through the soil mantle. A large part of the water cycle consists of surface runoff and surface storage within the tundra ecosystem.

Solar radiation is unique in the tundra and light is almost continuous throughout the short growing season. It is intense and high in ultraviolet rays. Characteristically, cold, desert-like, drying summer winds produce high rates of evaporation and transpiration. Thus, water is often a critical factor.

Production of the terrestrial and aquatic ecosystems is dominated by a short growing season of 45-90 days. The first two or three weeks of the growing season and the previous summer stand reserves are critical to the energy flow.

The food chain is relatively short and any radical change in numbers at any of the three trophic levels has violent repercussions on the other levels, because there is often little in the way of alternate choices of food.

Even though ecologically simple, the tundra ecosystem is extremely delicate and responds dramatically to seemingly minor perturbations. This response is, in part, the result of increased energy flow into the upper substrata as the insulating covers of vegetation and peat are grazed, physically disrupted, or removed. This results in acceleration of thaw and rapid erosion of the underlying ice-rich permafrost.

Tundra ecosystems are a complex mosaic of vegetation, soil, microrelief and aquatic environments. Flora and fauna and scenic

attractions are fairly well known, but ecosystems have not been sufficiently studied. Impacts of a single action on a specific area may be foreseen but knowledge of cumulative effects is lacking. Therefore, any proposed actions should be evaluated in terms of the potential rapid deterioration and extremely slow rate of recovery.

A more intensive examination of the tundra ecosystem and the probable impacts of oil and gas activities are found in the U.S. Department of the Interior environmental impact statement on the proposed Trans-Alaska Pipeline.

Topography

Arctic tundra is found from the flat coastal areas along the Arctic Ocean to the moderate and steeply sloping mountains with 1,000 to 3,000 feet of relief along the west end of the Brooks Range. Arctic tundra is also found along the west coast at the mouth of the Kobuk and Noata Rivers, which are flat open plains as is the northwest coast of the Seward Peninsula. Low to high gently sloping hills with 500 to 1,000 feet of relief are the predominant topographic features of north and central areas of the Seward Peninsula while the southern coast has predominantly low gently sloping mountains with 1,000 to 3,000 feet of relief. The steeply sloping mountains along the west end of the Peninsula lack vegetative cover, the Tundra being restricted to a few inter-mountain valleys and the gently sloping hills or flat areas near the coast.

Topography of the western tundra varies from the flat plains along the Yukon and Kuskokwim Rivers to the high moderately sloping mountains with over 3,000 feet of relief located along the southwestern coast. In the Aleutians, topography ranges from smooth gently sloping plains along the northern coastal areas to the high mountainous areas; relief also varies from island to island.

Climate

The Tundra biome is characterized by a mild polar climate in the north and a rainy climate with severe winters in the south.

During winter, the Arctic high pressure system brings a rather dry cold flow of air to the northern part of the biome. At the same time, this high pressure system picks up moist air from the Gulf of Alaska and deposits it along the western coast of Alaska. In the summer, a low pressure system develops off the west coast of Alaska, resulting in rather wet months of July, August, and September. Average annual precipitation ranges from 8 inches along the Arctic coast to 16 inches at Nome, 20 inches at Bethel, and 60 inches at Kodiak.

Temperatures in the biome are influenced by latitude and the movement of air in relationship to the land mass. In the north during January, the air flow is from a cold continental air mass causing temperatures to average 10° F below zero. During this period, the mean annual temperature warms progressively to the south where at

Kodiak the temperature in January averages 30° F above zero. Average July temperatures vary little - from 40° F in the north to 50° F in the south.

Growing season also fluctuates with latitude. The western coast area averages about 100 days a year. Under the influence of prolonged daylight, however, vegetation makes rapid growth.

Vegetation

Vegetation in the Tundra Biome is structurally simple and is dominated by a single growth form of low-statured grasses and sedges. Herbaceous and woody vegetation such as willows and birch are also present but consist only of species which are similarly low-statured or even prostrate.

Essentially an arctic grassland, the tundra is a treeless area with many lichens and mosses. During the short growing season, temperature is often near the lower limit of biological activity. Nearly all plants are perennial and annual production is low. Total annual increment of bound energy into the ecosystem is small.

A thick, spongy mat of living and undecayed vegetation, often saturated with water and interspersed ponds, characterizes the low tundra when not frozen. The high tundra on steep slopes may support only a scanty growth of lichens and grasses.

Vegetation of the tundra forms an insulating layer which is critical to the stability of the ecosystem. Removal of vegetation can result in degradation of permafrost leading to erosion and thermokarst. Thus, even the microstructure of vegetation is very important.

Soils

Soils of the north slope coastal areas, the areas around the mouth of the Kobuk, Noata, Yukon and Kuskokwim and other rivers as well as the north coast of the Seward Peninsula and the north coast of the Aleutians are Quaternary sediments, while the sediments exposed in the Brooks Range and on the Seward Peninsula are mainly of Upper Paleozoic Age. Mountains which reach the ocean along the southwest coast are composed of Cretaceous Age sediments while the islands of the Aleutian chain are predominantly Quaternary and Tertiary Age volcanic rocks.

Factors controlling permafrost occur in the Tundra Biome and are very significant. The perma-frost zone along the northern coastal areas is as much as 2,000 feet thick, much of it being "ice rich" or, in reality, a layer of ice with inclusions of sediments. The permafrost thins to the south and the ice-soil ratio decreases; however, it is continuous far south of the Brooks Range.

Disruption of the equilibrium can have serious effects with rapid soil erosion and massive slumping. Sensitivity to such damage is directly proportional to the water content of permafrost soil.

Dry, gravelly permafrost soils are affected little by disturbance-induced thawing, while wet, silty permafrost soils (called "ice-rich") are very susceptible to oozing and slumpage when thawed.

Wildlife-Terrestrial

Due to low temperatures, short growing seasons, low precipitation, and intermittent freezing and thawing of the thick, spongy mat of low tundra vegetation, bacterial action is very slow. Even the high tundra may be bare except for scanty growth of lichens and other low plants. Yet, many mammals and birds remain throughout the year, including: caribou, musk ox, arctic hare, arctic fox, lemming, and ptarmigan. Violent oscillations in population density of some animals are characteristic, e.g., lemmings and the dependent owls and jaegers that prey on them; also, the snowshoe hare and lynx cycles. Other characteristic mammals of the arctic slope and north of the Brooks Range include the polar bear, arctic wolf, wolverine, Alaska red fox, marmots, Parry's ground squirrel, red-backed mouse, and several voles and shrews.

Bird life is remarkable for its vast abundance in the brief summer. Waterfowl especially gather in large numbers to nest and rear their young. Few birds remain in winter when even the snowy owl may move southward. Willow ptarmigan usually are present year-round.

An outstanding feature of the low tundra community is the great number of dipterous (fly family). Most hibernating insects withstand temperatures down to -50° F. Mosquitoes, gnats, flies,

beetles, bugs, bumblebees, wasps, moth larvae, spiders, and mites may overwinter in plant tufts and under stones and driftwood. Aquatic insects and larvae either burrow into mud or pass the winter in the egg stage.

The uplands are inhabited by caribou (except in winter), Dall's sheep, some grizzly bears, marmot, ground squirrel, rock ptarmigan, horned lark, and lapland longspur. There are no reptiles and no known amphibians.

Wildlife - Aquatic

The tundra biome lakes, ponds, and bogs do not support large populations of aquatic life due to lack of minerals and nutrients. Resident fish grow slowly but due to isolation may grow to a large size because of age. Characteristic fish are chars, grayling, and whitefish. Chars are lake trout (mackinaw) and arctic char. Arctic grayling is abundant and well distributed in tundra waters. Sheefish inhabits the major rivers. Anadromous fish that spend part of their life cycle in tundra streams are chum and pink salmon. These fish enter streams, deposit eggs, and the hatched fry migrate quickly to the ocean. Sockeye salmon use streams with lakes in headwaters. Fry migrate from streams and spend one or two years in a lake prior to sea migration.

Wildlife - Endangered Species

Musk ox is listed as rare within the tundra biome. Status of the following species is at present undetermined: polar bear, pine marten, wolverine, and Canada lynx. One rare fish is presently listed: the Angayukaksurak char of the north slope of the Brooks Range.

Tundra waters are generally of such high purity that any influence of man can be detected in water quality and changes in aquatic biota.

Water

Major water resources of the tundra biome in northern and western Alaska are streams, rivers, and many natural water bodies such as lakes, ponds, and marshes. Presence of permafrost causes ground water supplies to be limited because of restrictions to recharge. Surface waters of the tundra biome drain seaward and empty directly into the Bering, Chukchi, and Beaufort Seas. Quality of both surface and ground water is generally good except for glacier-fed streams which are high in sediment content and some ground waters which have excessive amounts of dissolved iron.

Surface Water

Surface water resources of the tundra biome include streams, rivers, ponds, lakes, marshes, bogs, and swamps. These surface waters are used for domestic, municipal, recreation, and fish and wildlife

purposes. Natural water bodies such as lakes, ponds, and marshes are very important to recreation and fish and wildlife uses.

Average annual precipitation ranges from less than 10 inches to 30 inches and average annual runoff varies with annual precipitation. However, little is known about actual water yields in the tundra areas. Due to low potential evapotranspiration, the tundra is a water surplus area.

The quality of most surface waters is good except in two specific situations: (1) the sediment content of glacier-fed streams and rivers is high; (2) surface waters that derive from extensive swamp areas are usually high in organic and iron content because the drainage of such areas is often restricted by impermeable subsurface materials, including permafrost.

Ground Water

Little is known about the ground water resources of the tundra biome. Generally, in areas underlain by permafrost, ground water is extremely difficult to obtain. Limited ground water supplies that are available are used for such purposes as domestic, municipal, recreation, and fish and wildlife supplies.

The quality of ground water varies in the tundra areas with some low in dissolved solids (less than 200 ppm) while others are high in dissolved iron content.

[illegible]

[illegible]

The quality of [illegible]

Ground Water

[illegible]

The quality of [illegible]

Environmental Influences

Domestic Livestock.

The only domestic livestock supported by the Alaska Tundra are reindeer herds. These fit the term "domestic" only in the sense that they are loosely herded, and an attempt is made to keep them separated from the wild caribou herds. Reindeer are completely compatible with caribou and will join the caribou and revert to the wild state if allowed to mingle.

Reindeer were introduced to Alaska from Lapland to provide a reliable source of meet for the Eskimos and make them less dependent on wild species for food supplies. By law, only native Eskimos are permitted to utilize reindeer on a managed herd basis. Management and control is generally by family units and grazing is year-long.

Minerals

Leasable minerals, coal and phosphate, are found primarily in the Cretaceous and Tertiary sediments on the north and south slopes, respectively, of the Brooks Range in Arctic Alaska. North slope coal lies in the same general area found to contain large oil and gas reserves. Arctic coal ranges from Anthracites through Sub-bituminous to medium and high volatile bituminous. Sulfur is found near the western end of the Alaskan Peninsula. These are related to the Paleozoic sediments.

Human Settlement and Land Use

Harsh conditions of the tundra biome have limited settlement to small villages along the coastline and major rivers. Most inhabitants, aboriginal and white alike, are dependent on the surrounding natural resources for subsistence or livelihood.

Eskimos, who make up about one-half of the State's native population, live along the Bering and Arctic seacoasts. The Aleutian people are the smallest native group and have traditionally lived along the Alaskan Peninsula and Aleutian chain of islands.

The native Alaska population shows a 27% increase in 1950-1960 and a 19.5% increase in 1960-1970. Improved health care has partially arrested high infant death rates but the native population continues to have various health problems above the national norms.

Fishing and hunting historically have been a sole means of survival for natives on the tundra. Incomes and cost of living for immigrants or whites is very high compared to the lower 48 states. The Eskimo, trying to live according to higher white standards, on an Eskimo income, is in a serious predicament. Public assistance to native peoples represents a significant portion of their cash income, and employment opportunities are poor. Conflicts between native culture and modern society present a thorny problem. Many native peoples wish to adopt certain aspects of modern society including

a higher standard of living, but differences between cultures make the transition difficult. Native cultures and value systems are poorly understood by contemporary white Americans.

Minerals and mining have been a primary thrust for exploration and development of the tundra region. Initially, gold discoveries on the Seward Peninsula resulted in a flurry of development which was followed by intensive prospecting throughout the region. This resulted in the discovery and mining of numerous mineral deposits in addition to gold. More recently, sizeable goil and gas discoveries at Prudhoe Bay have been made.

Tourism is expected to be a future important source of income which would utilize the areas of vast undeveloped natural resources for recreational purposes. Hunting and fishing are steadily increasing aided by the use of small aircraft and all-terrain vehicles.

The tundra is unproductive in an agricultural land-use sense due to extremely harsh winters and short growing seasons.

Aesthetics

Land form in the tundra biome is the low rolling nealy flat form common to grasslands. Texture is the extremely fine soft texture of the tundra itself and almost indistinguishable except at very close range.

Color is the soft monotone gray-green of the vegetation and is interrupted only by an occasional stream meandering through on its way to the sea, and lines are almost non-existent in any form. Scale, as in the grasslands, is very difficult to define. There is almost nothing verticle to relate to. Altogether the tundra does not hold a great deal of interest to the seeker of scenic value. Yet, because it is so plain and so much the same, almost any disruption or intrusion immediately becomes the focal point for the observer.

Geological Human Interest Values

Features of geological interest are limited. There are normal effects of glaciation, coastal erosional features, and the results of permafrost and other extreme freeze action on the land surface, such as pingoes, the small raised islands of ice. In the Aleutian chain are evidences of volcanic construction. Surprisingly, there are two small deserts along the Taiga to tundra transition zone that are replete with sand dunes.

Archeological Values

The tundra biome is basically sunonymous with the Eskimo and Aleut culture areas or the Arctic Tradition. Aleuts, linguistically related to the Eskimo, live on the Aleutian Island chain. The western Arctic, represented in Alaska because of its proximity to the old world, continually received stimuli from it from the first recognizable cultures.

There are evidences of both the Old Cordilleran Tradition and the Big Game Hunter Tradition in earliest Alaska. This was followed by the Northwest Microblade Tradition characterized by numerous microblades struck from conical cores. Next, a tradition known as the Arctic Small Tool Tradition is characterized by a unique style in fine pressure flaked flint and small tools, as the name indicates. Last to be found is the Eskimo Tradition, which probably began some 4,000 years ago. All of the traditions lived along the seacoast for the most part, living by hunting the large sea animals, catching fish, and hunting caribou and other animals inland. Many of the better gravel bars and sand spits were occupied by pit and surface houses for thousands of years, each beach strand frequently representing a different time period or culture.

Historical Values

The history of the tundra biome follows early periods of exploration by the English, Russians, and Americans. A trading period involved mostly the Russians and later some Russian settlements. Purchase of the Alaskan Territory by the United States in 1867 brought increased exploration by the Americans. Gold rushes in the late 19th century stimulated some settlement, while World War II and the ensuing "Cold War," brought the military, with civilian support, in great numbers to remote locations.

Some of the more recent history is probably the most important in the Tundra. Japanese occupation during World War II of parts of the Aleutians and recent Atomic Energy Commission testing have significance.

Cultural, Ethnic and Religious Values

Eskimos and Aleuts in the tundra biome are, along with the Athabascans in interior Alaska, one of the largest groups of native peoples living any sort of life resembling that at contact times. Changes are becoming more rapid though, as modern "civilization" encroaches on the native villages and their way of life. Old subsistence patterns are breaking down as more dependence is put on white man's foods. Even the sled dog is disappearing as the snowmobile takes their place. The kayak and umiak are giving way to the outboard motor boat.

There is a counter, cultural reinforcement effort being launched, however, as forgotten native crafts are being retaught by Bureau of Indian Affairs teachers. Some of the better native art works today come from communities in which this teaching has been done. The American Indian movement is also bringing renewed interest in cultural heritage to the native peoples of Alaska.

Unique Management Problems

Domestic livestock grazing is not important in this biome; therefore, implementation of the intensive management proposal should not be attempted except on very minor segments dominated by grasses.

However, man has inadvertently caused severe oscillations by introducing the domestic reindeer. Unlike caribou, reindeer do not migrate; they are herded from place to place to prevent overgrazing but herding is not a part of the culture of Alaskan Indians and Eskimos. As a result, reindeer have severely overgrazed many areas, reducing the carrying capacity for caribou as well.

Of prime importance in an intensive management program, for reindeer and livestock, would be protection of the delicate mantle of vegetation that protects the permafrost and maintenance of high quality aquatic habitat.

Alphabetical Listing of References for Description of Biomes

Allee, W.C., et. al. Principles of Animal Ecology. W.B. Saunders Co., Philadelphia, 837 pp.

Anonymous. 1941. Climate and Man. U.S. Government Printing Office. 1248 pp.

Anonymous. 1970. The National Atlas of the United States of America. U.S. Government Printing Office.

Anonymous. 1971. Fish and Wildlife. Appendix XIII, Great Basin Region Comprehensive Framework Study, Pacific Southwest Interagency Committee, Water Resources Council.

Anonymous. 1971. Fish and Wildlife. Appendix XIII, Lower Colorado Region Comprehensive Framework Study, Pacific Southwest Interagency Committee, Water Resources Council.

Battelle Memorial Institute. 1972. An Analysis of the Economic Structure and Industrial Potential of the Four Corners Region - A Report Prepared for the Four Corners Regional Commission. p. 3-57.

Bliss, L.C. 1971. Arctic and Alpine Plant Life Cycles. Annual Review of Ecology and Systematics 2:405-438.

Brooks, James T., et. al. 1971. Environmental Influences of Oil and Gas Development in the Arctic Slope and Beaufort Sea. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife Resource Published 96.

Brubaker, S. 1972. To Live on Earth. Published for Resources for the Future by John Hopkins Press, Baltimore. 202 pp.

Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Rare and Endangered Fish and Wildlife of the United States, Resource Publ. 34, Rev. ed., 1968.

Bureau of the Census, U.S. Department of Commerce, Statistical Abstract of the United States, U.S. Government Printing Office, 68th ed., 1947.

Bureau of the Census, U.S. Department of Commerce, Statistical Abstract of the United States, U.S. Government Printing Office, 86th ed., 1965.

Bureau of the Census, U.S. Department of Commerce. Statistical Abstract of the United States. U.S. Government Printing Office. 91st ed., 1970.

Bureau of the Census, 1970 Census of Population, U.S. Summary. Government Printing Office, 1971.

Carlander, K. 1969. Handbook of Freshwater Fishery Biology, 3rd. ed. Iowa State University Press. 720 pp.

Costello, David F. 1972. The Desert World. Thomas Y. Crowell Co., New York.

Dix, R. L. and R. G. Beidleman (Editors), 1969. The Grassland Ecosystem: A Preliminary Synthesis. Series #2, 437 pp.

Schubert, G. 1967. [illegible]. Published for Resources for the Future by The Johns Hopkins Press, Baltimore. [illegible] pp.

Bureau of [illegible] and [illegible], U.S. Department of the Interior. 1965 and [illegible] of the United States. Resource Publ. [illegible], 1966.

Bureau of the Census, U.S. Department of Commerce. Statistical Abstract of the United States. U.S. Government Printing Office, [illegible] ed., 1970.

Bureau of the Census, U.S. Department of Commerce. Statistical Abstract of the United States. U.S. Government Printing Office, [illegible] ed., 1965.

Bureau of the Census, U.S. Department of Commerce. Statistical Abstract of the United States. U.S. Government Printing Office, [illegible] ed., 1950.

Bureau of the Census. 1970 Census of Population, U.S. Summary. Government Printing Office, 1972.

Carlander, K. 1969. Handbook of Freshwater Fishery Biology, Vol. 1. Iowa State University Press. 752 pp.

[illegible] 1971. [illegible]. Thomas Y. Crowell Co., New York.

Cox, [illegible] and [illegible] 1971. [illegible]: A Preliminary [illegible] pp.

Dix, R. L. and R. G. Beidleman (Editors). 1970 The Grassland Ecosystem: A Supplement. 110 pp.

Everhart, W. H. and W. R. Seamon. 1971. Fishes of Colorado. Colorado Game, Fish and Parks Division. 75 pp.

Fish and Wildlife Service, U.S. Department of the Interior. 1952. Distribution and Status of the Important Fish and Wildlife, Missouri River Basin, Billings, Montana, 226 pp.

French, Norman R. (Editor). 1971. Preliminary Analysis of Structure and Function in Grasslands. Series #10. 387 pp.

Friedmann, John and William Alonso (Editors). 1964. Regional Development and Planning. Massachusetts Institute of Technology Press, Cambridge. 223 pp.

Hansen, Henry P. (Editor). 1967. Arctic Biology. Proceedings of 1957 and 1965 Biology Colloguhum, Oregon State University, Corvallis, Oregon. 243 pp.

Hodge, Carle and Peter C. Drisherg (Editor). 1963. Aridity and Man; the Challenge of the Arid Lands in the United States. Committee on Desert and Arid Zone Research, American Association for the Advancement of Science. Publication 74. 584 pp.

Hunt, Charles B. 1967. Physiography of the United States, W. H. Freeman and Company.

Lagler, Karl. 1966. Freshwater Biology, University of Michigan.

Metzger, R. E. 1972. The Role of Microorganisms in Desert Soils, Unpublished Monogram. 5 pp.

Miller, Robert Rush. 1972. Threatened Freshwater Fishes of the United States. Transactions American Fisheries Society 101(2): 239-252.

Odum, Eugene P. 1959. Fundamentals of Ecology. 2nd. ed. W. B. Saunders Co., Philadelphia and London. 546 pp.

Odum, Eugene P. 1971. Fundamentals of Ecology. W. B. Saunders Co., Philadelphia and London.

Odum, Eugene P. 1945. The Concept of the Biome as Applied to the Distribution of North American Birds. Wilson Bulletin 57(3): 191-201.

Oosting,Henry J. 1950. The Study of Planet Communities. W. H. Freeman Co., San Francisco. 389 pp.

Paris, O. H. 1969. The Function of Soil Fauna in Grassland Ecosystems. In The Grassland Ecosystem, Proc. of the Information Synthesis Project, Grassland Biome, U.S. I.B.P., Colorado State University, Ft. Collins, pp. 331-355.

Petterssen, Suerre. 1940. Weather Analysis and Forecasting. McGraw-Hill Book Company.

Research Programs Constituting U.S. Participation in the International Biological Program. Report #4 of the U.S. National Committee for the IBP, National Academy of Sciences, Washington, D.C., 1971.

Shelford, Victor E. 1963. The Ecology of North America University of Illinois Press, Urbana. 610 pp.

Tundra Biome Symposium Proceedings. U.S.I.B.P. and U.S. Arctic Research Program, 1972.

U.S. Tundra Biome Program of the U.S. International Biological Program and U.S. Arctic Research Program, The Structure and Function of the Tundra Ecosystem. Volume 1 Progress Report and Proposal Abstracts, 1971.

U.S. Department of the Interior. 1972. Final Environmental Statement of Proposed Trans-Alaska Pipeline. U.S. Department of Commerce, Springfield, Va.

U.S. Water Resources Council. 1968. The Nation's Water Resources (Regional Overview). U.S. Government Printing Office, Washington, D.C.

U.S. International Biological Program. 1971. Report No. 4.

Willey, Gordon R. 1966. An Introduction to American Archeology. Prentice-Hall, Englewood Cliffs, New Jersey. 516 pp.

4. Environmental Impacts

III. Environmental Impacts of the Proposed Action

National resource lands used for livestock grazing are seldom mature, self-perpetuating ecosystems. In many cases, a mature ecosystem is not desirable since the cycling energy is used primarily to maintain the mature ecosystem rather than in primary production. An example is an over-mature, somewhat decadent even-aged forest. Growth, for all practical purposes, has ceased. Normally, production of the biomass, including animals, from immature or disclimax plant communities is sometimes much greater than that from mature communities. Diversity in the vegetative component makes better utilization of the energy and provides a longer food chain, less apt to be totally disrupted by normal, or even violent, oscillations in plant and animal life. Some rangeland ecosystems may have reached maturity at some time and since regressed, largely through man's activities, to various seral stages; others have never reached maturity or are prevented from achieving maturity by natural forces such as recurring wildfires, floods and natural geologic erosion, or continuous concentrations of game animals.

Several characteristics of livestock grazing on national resource lands are recognized as problems. Among these are:

A. Poor distribution of animals due to lack of, or poor location of,drinking water results in overgrazing of some areas and lack of utilization in others.

B. Year-long use or continuous seasonal use, year-after-year, does not provide periods of rest for plants to regain vigor and complete their normal life cycle. Grazing during the winter season only is less damaging to plants than grazing during seasons of plant growth (spring and summer).

C. Improper season of use can be damaging to both plants, soil, and associated wildlife. For example, grazing in the spring during a critical stage of plant growth removes vital photosynthetic tissue and retards completion of the life cycle. During this period, grazing may remove broad-leaf succulents necessary for the nutrition of game animals and birds. Soil may still be moist and spongy from winter moisture and trampling and compaction may result. Livestock grazing in winter may cause significant competition for browse on a critical winter deer range.

D. Improper class of livestock may pose problems in some areas. Some vegetative communities are better suited to grazing by sheep rather than cattle or vice versa.

E. Continuous heavy utilization of the vegetation results from grazing too many animals too long, exceeding the carrying capacity of the vegetation. This may be due, in part, to poor distribution where easily accessible areas are continuously grazed heavily; or to continuous seasonal or yearlong use by too many animals.

F. Selective grazing by all herbivores, choosing forage species that are most palatable at any particular season, results in finally destroying these preferred species and replacement by other less palatable plants which now have an ecological advantage and can compete more strongly for soil nutrients, water, light, and space.

The proposed intensive management program will ameliorate some of these problems. The program includes development of sufficient water, properly located where feasible, and construction of fences to divide the unit into two or more pastures. Providing water and confining animals into smaller pasture sub-divisions forces better distribution of animals in their search to fulfill their forage requirements. In essence, animals are concentrated in a smaller unit and, in their foraging habits, will make more uniform use of the entire unit. Since utilization of the vegetation will now become more uniform throughout the pasture, the problem of livestock concentrations in accessible areas and around water is somewhat ameliorated and "spots" of heavy utilization will not be so prevalent. Then, too, when the animals are rotated to another pasture, previously grazed plants are permitted to rest and recover their vigor.

Selective grazing of the more palatable plants and plant parts is also diminished by intensive management. Animals confined in pastures are forced to utilize plants they would not otherwise choose. These less preferred species may be just as nutritious as others but are seldom grazed. When all plants are utilized uniformly, the ecological

advantage and competition is at least equalized and may actually shift in favor of those naturally adapted to the site over those which may be "intruders."

The proposed intensive management program will solve the problems of continuous year-long and seasonal use on the same area each year. Rotation of animals among pastures, providing periodic rest from grazing during critical periods of plant development, will break up this pattern of unmanaged indiscriminate grazing.

Problems of improper season of use and improper class of livestock can be solved by present regulatory authority. Improper season of use, however, will also be partially solved by intensive management. A pasture within a grazing allotment may still be grazed during a particular season in the normal rotation sequence; but the pasture is then also rested from grazing sufficient to restore plant vigor and it is not grazed again at the same season until the rotation cycle is completed. Livestock can be rotated off of critical winter game range in sufficient time so that vegetative growth of browse twigs is not impaired and the forage is "saved" for winter deer use.

ECONOMIC IMPACTS OF GRAZING ON OTHER USES

According to Marion Clawson and Burnell Held in their book, The Federal Lands, when speaking of conflicts concerning grazing and other uses, and the goals for use of these lands, they say:

> "Perhaps a better general goal is maximization of the public welfare, insofar as the federal lands can affect such welfare. This would involve, for salable products, getting the most out of their contribution to the national product and, for non-salable products, making them as fully available as is compatible with cost. A major complication arises when maximization of the national product from salable resources conflicts with maximization of the availability of other resources". (Clawson & Held, 1957)

The essence of the above quote is that there are growing pressures for changes in the use of public lands in the West. Agencies change policies and programs only after society indicates a desire for change. The public land agencies administer laws developed by legislators who represent the desires of their constituents. Some of the most pronounced influences now affecting the desires of the general public with respect to public land use of the West are population increases and shifts, increased leisure time, increased income per capita, improved transportation facilities and increased demand for extensive types of outdoor recreation.

During recent years population has been increasing at a rate of approximately 1.5 percent per year. Between 1960 and 1980 the overall population in the United States is expected to increase nearly 33 percent. But, in the West this increase is expected to approach a 65 percent increase. Population is also shifting more and more from rural to urban areas. It is projected that by 1980, 77 percent of the population will live in urban areas as contrasted to 56 percent in 1940 (Roberts, 1963).

Leisure time has increased due to longer paid vacations. Incomes have generally been increasing at a rate in excess of inflation rates. The interstate highway system and increased mileage of other improved highways has made travel to the West faster and safer. In addition, the increasing trend towards recreation vehicles that allow travelers to travel in comfort and more-or-less take their home with them has increased recreation travel and made it more enjoyable. Additionally, the public is demanding use of public land for the extensive types of recreation that may be found there. It has been estimated that these activities will increase 40 times between 1956 and the year 2000 (Clawson, 1961).

All these pressures tend to increase the demand for use of the national resource lands for public uses that may be compatible or, in some cases, compete with grazing. Some of these other uses include all forms of outdoor recreation, watershed management, wildlife management, forest management, and mineral development. Each of these other uses have economic value. But the values of some are harder to measure than others. Grazing, forestry, and mineral values are much easier to derive than are the values for recreation, watershed, and wildlife. In fact, these latter three often defy direct value measurement schemes and have to be estimated methods.

IMPACTS

Influences of grazing on any particular component of an ecosystem within a biome will be somewhat similar. For example, impacts of grazing on soil compaction will be similar on most all soils, varying primarily by magnitude or degree of impact. Therefore, such impacts are best described by the influence on specific components of the ecosystem rather than each item in each biome.

Removal of Products

Theoretically, a balanced ecosystem converts and transfers energy and minerals throughout the food chain so that they are ultimately transformed and re-deposited into the cycle to be used over and over. Few ecosystems exist that do not have inputs from other ecosystems and whose outputs do not influence adjoining systems.

A subtle impact of livestock grazing is removal of energy from the ecosystem in the form of livestock products (meat, milk, wool, hides, etc.). However, vegetation is a renewable resource and recaptures new energy when maintained in a healthy condition by intensive management. The minute amount of soil minerals removed are restored by normal weathering of soil parent materials and other natural processes.

Vegetative Cover

Livestock grazing removes vegetative cover directly by removing leaves and stems of the plants and by consuming material that would otherwise fall to the soil surface as litter and finally become incorporated into the soil component as humus.

The impact of grazing on timber production is usually found to be detrimental only when stocking rates are too great and animals are forced to eat young tree seedlings. Generally speaking, timber and woodland production may be more likely to compete with grazing. This is especially true where species of pinion and juniper are predominant and compete with animal forage for water. For optimum forage production, these species should be minimized, but they do have aesthetic value and some commerical and private values as fence posts, firewood, pine nuts and Christmas trees.

Opening the timber canopy by logging permits understory vegetation to develop and provides grazing for foraging animals. Removal of some vegetative cover by grazing, particularly understory vegetation in forest biome ecosystems, may beneficially limit the incidence of destructive wildfires. However, the change in or destruction of vegetative cover by continuous improper grazing may cause a long and complex chain of ecological consequences. Soil becomes more exposed, thus changing the microclimate (primarily temperature and soil moisture) and soil microorganisms. The site tends toward aridity. Other plant and animal species are better adapted to these conditions and invade the distrubed area. Escape cover for wildlife is reduced or changed resulting in shifts in wildlife and insect populations. Removal of the canopy of photosynthetic tissue above ground also has repercussions below ground in the root system. A plant low in vigor from continuous removal of food-manufacturing organs also has a poorly developed root system. Depth and spread of roots is restricted,

thus limiting the volume of soil from which minerals and moisture can be absorbed. They are less effective in binding the soil against forces of erosion and plants cannot withstand the stress of drought as well. Removal of overhanging vegetative cover from streambacks or shoreline and emergent vegetation from other aquatic habitats raises water temperature, increases siltation, and destroys important nesting habitat for waterfowl.

Soil Erosion

There is very little of the western range where, because of the destruction of plant cover by improper management, accelerated erosion has not destroyed a portion of the soil mantle, and thus reduced the productivity of the site. Results of the studies (Senate Document No. 199) published in 1936 estimated that about 67 percent of the national resource rangelands were in a depleted condition. During the previous 30-year period, 95 percent of the lands had regressed ecologically and only 2 percent had improved. At that time, over 80 percent of the western rangelands were suffering from serious soil erosion resulting in addition of silt loads to streams whose waters were important for various downstream uses.

According to Clawson (1971) "Good grazing management is a first step toward good watershed management, for it removes a major cause of deterioration of the vegetative cover and allows for the natural processes of nature ot operate." He goes on to say that even areas of

low rainfall that exist in much of the BLM grazing districts will produce natural vegetation to heal the erosion caused by former abuse due to poor management. Nevertheless, there are steep lands and areas with highly erodible soils that should be restricted from grazing. These include stream banks where grazing and trampling cause erosion. The costs of damaging the watershed are usually in excess of the values produced by the grazing of such areas.

Reduction or removal of vegetation cover by unmanaged continuous grazing exposes soil to erosion by wind and water resulting in air and water pollution. Impact by falling rain is not cushioned by a protective vegetation cover, resulting in sealing and compacting the soil. Runoff accelerates, resulting in off-site and downstream flooding, siltation, and destruction of property. Soil fertility and soil are lost by sheet, rill, and gully erosion, thus the productive capability of the soil is drastically reduced or destroyed. In addition, an eroded landscape, except for spectacular canyons, grotesque formations, and "badlands" is aesthetically unacceptable. Gullies lower the water table, particularly noticeable in mountain meadows, further reducing the productive capability of the remaining soil.

The intensive management program is based on the harvesting of forage without disrupting normal life processes of plants. Management systems, therefore, are designed to provide uninhibited plant development and the rotation of livestock among pastures, with periodic properly-timed

rest from grazing, permits natural ecological and physiological forces to develop normally. Plant vigor will be restored and bare soil spaces will be occupied by new plants, encouraging the maximum vegetative cover the site is capable of producing and supporting.

Healthy stands of perennial vegetation forms a protective mantle and penetrating spreading root system that effectively protects soil from damage caused by raindrop impact, intensive rainstorms, and wind. Under intensive management, entire pastures are rested from grazing for an entire year or longer. Vegetative material not consumed falls to the soil surface as litter, adding additional soil protection, and is eventually incorporated into the soil as humus. Humus performs important functions in the soil, supporting bacterial life, enriching the soil, increasing moisture absorption and retention capacity, and reducing runoff and subsequent erosion.

Healthy vigorous vegetation resulting from intensive management is not only nature's most effective means of protecting soil and water but also provides an aesthetically pleasing landscape. Effects of drought are not so damaging or long-lasting since the vegetation is healthier and better able to respond to a return to normal climatic conditions. A vigorous healthy vegetation community is more likely to support a normal stable wildlife population with adequate and varied vegetative escape cover.

Under the intensive management proposal, some pastures will be grazed heavier than others thereby reducing vegetative cover and litter temporarily. However, rest from grazing will permit the vegetative cover to be re-established. Where tree seedlings are becoming established following logging, the grazing system can be designed to permit normal development of the seedlings. The rotation cycle may have to be somewhat longer to allow seedlings to grow sufficiently so that they are out of reach by foraging animals.

Vegetation Composition

With unmanaged continuous livestock grazing, species preferred by livestock are selectively grazed, weakened, and eventually may die, setting into motion a series of ecological regressions which, if unregulated grazing pressure continues, will terminate in a relatively useless weed patch. Spaces formerly occupied by desirable vegetative species become occupied by vegetative species frequently less protective of the soil and less desirable as animal forage and escape cover. Continuous, indiscriminate, grazing not only causes significant changes in vegetation composition and in associated fauna, but also depletes the ground fuel necessary for natural fires which frequently would sweep for miles on a broad front according to historical accounts. Change of vegetative composition and suppression of fires permitted certain brush species to gain persistent control of the ecosystem.

Examples include mesquite in the southern temperate grassland and desert biomes, pinyon-juniper in the desert and woodland-bushland biomes, and sagebrush in the grassland and cold desert biomes. Although naturally confined to restricted sites, their territory has since greatly expanded.

Continuous unmanaged grazing often causes such modification in soil characteristics, including erosion, that the site is no longer capable of supporting vegetation originally growing on the site. In addition to the invasion by brush species, annual grasses such as cheat grass, medusa-head, and six-weeks grama are also well adapted to the modified more arid site. These shallow-rooted species mature early and become dry providing an abundance of explosive fuel for wildfires, little protective cover on the watershed, and erratic forage production.

Implementation of the intensive management proposal will permit use of the grazing animal as a "tool" in directing natural ecological succession toward desirable plant and animal communities. Periodic rest from grazing permits plants to gain vigor and produce viable seed which is then scattered and planted by livestock grazing. New seedlings are permitted to become established, thus changing the composition toward a more productive ecosystem. Ecologically adapted species will be provided a competitive advantage by intensive management over invader species not well adapted or having shallow root systems. Grazing use can be directed and timed under the intensive management proposal to favor one life form over another. For example,

on a critical big game range where brush is vitally important as wildlife food and cover, grazing on perennial grass species at a critical period will lessen competition with the brush, increasing its vigor and composition in the community.

Fire is not apt to be so prevalent or destructive in a diverse community of perennial plants because they remain green longer than annuals and some perennials are still green as others mature and become dry fuel. Even after burning the perennial roots will immediately begin growing new shoots (provided moisture is present) which reclothes the watershed with protective vegetation.

In some biomes, particularly the California Grassland, management to restore perennial species is presently not feasible. Intensive management, in this situation, is designed to maintain a desirable composition of annuals, graze off the bulk of the potential fuel, but still maintain adequate stubble and litter residue to protect the watershed.

Quality of Wildlife Habitat

The Bureau of Land Management Annual Wildlife Report for Fiscal Year 1971 indicates the following amounts of fish and wildlife habitat is in "unsatisfactory" condition: 44 percent of the big game range (46 million acres of 104 million acres), 29 percent of the small game range (33 million of 111 million acres), 58 percent of the waterfowl habitat (463,000 of 799,000 acres), 38 percent of the lakes and reservoirs (812,000 of 2,100,000 acres), and 46 percent of the fishing streams (4,055 of 8,673 miles). The report states, "It is generally recognized

that most of the unsatisfactory condition can be related to excessive grazing by livestock." Some fisheries biologists express the opinion that livestock grazing has had a greater cumulative adverse effect on fish and fish habitat than has been caused by mining. If vegetative species are reduced in number and density through improper grazing management practices, food, cover, and living space for other life forms are reduced and reactions are initiated up and down the food chain. Some of these changes are very subtle and largely unnoticed as in the case of small organisms and insects. Others are more obvious such as destroying nesting cover for birdlife or grazing of early-developing spring succulents (with consequent reduction of associated insects) in mountain meadows which are vital to rearing sagegrouse chicks.

The areas administered by the BLM have traditionally been the homes for many species of wildlife. In many cases the areas provide only seasonal forage with lands in the national forest and private lands providing feed for the rest of the year. Deer utilize BLM lands in many areas for winter feed, using national forest areas and private lands during the warmer part of the year.

In the past, hunting was carried on as a means of providing food and hunting seasons were not a factor. Today, hunting provides local economies with income derived from persons seeking game during regulated

seasons. In many areas, expenditures of hunters provide a vital source of revenue to these local economies. Additionally there are intrinsic esthetic values which cannot be measured in dollars and cents that must be accounted for in regard to wildlife. The value of just seeing a deer or sagegrouse or other species of wildlife during a recreational outing is very high for most people, but the science of economics has not been able to place a monetary value on such an experience in order that it may be compared to grazing and similar values.

Grazing systems may be detrimental to wildlife habitat in some cases, while in others they may be beneficial. The primary source of conflict between livestock and wildlife is the real or imagined competition for forage. Forage preferences between the domestic livestock and big game species overlap only slightly on ranges in good condition because of the variety of plants to be found. The following diagram shows a hypothetical example of how deer and cattle grazing on a particular area may interact (Figure 2). Wildlife managers generally agree that this is a valid example. In the example, if land were given over entirely to deer the area would support 12,000 deer for a given season of use.

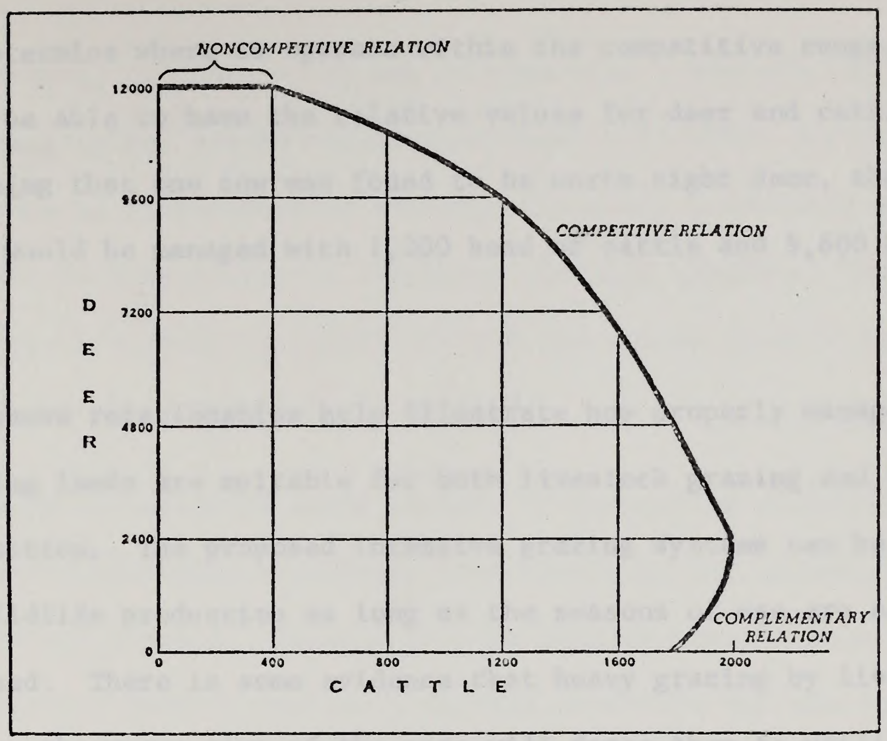

FIGURE 2 . *Interrelations of cattle and deer grazing—a hypothetical example of the production possibilities of a tract of range land.*

Source: Clawson and Held, 1957

If the area were used entirely for cattle, it would support 1800 cattle for the same season. Due to the differences in forage preference of the two types of animals, an assumed difference in plant species, and differences in terrain, some deer can exist and actually allow for an increase in cattle numbers to 2,000 head. A similar relationship could exist for cattle. But the relationship illustrated shows that by adding cattle to the area, where all deer had existed previously, 400 head of cattle could be added without detrimental effects upon deer numbers. Between 400 head of cattle and 2,400 head of deer, there exists a competitive relationship.

To determine where to operate within the competitive range, one must be able to have the relative values for deer and cattle. Assuming that one cow was found to be worth eight deer, then the area would be managed with 1,200 head of cattle and 9,600 head of deer.

The above relationships help illustrate how properly managed public grazing lands are suitable for both livestock grazing and big game production. The proposed intensive grazing systems can be beneficial to wildlife production as long as the seasons of use are adequately defined. There is some evidence that heavy grazing by livestock during the wrong time of the year will force them to utilize species of plants necessary for deer forage. In contrast, livestock grazing during other seasons will find the livestock grazing species of plants undesirable to deer and result in giving deer browse increased vigor.

Another detrimental effect of the proposed intensive management program is the disruption of migratory routes of big game by the fences required to implement the program. A benefit of the program is that it eliminates the need for the practice of eradicating sagebrush and other species of plants preferred by deer as part of a crested wheatgrass seeding. This practice often resulted in eliminating good deer winter range and also established a monoculture that was not acceptable to wildlife.

Therefore, in summary, it may be seen that a properly designed grazing system can be established which will allow for the maintenance or improvement of domestic livestock production and also result in maintaining or improving wildlife habitat. Thus, the livestock economy is stabilized and the values derived from wildlife are also protected or enhanced.

Streams or bodies of water capable of supporting fish and other aquatic life forms are highly susceptible to the effects of unmanaged livestock grazing. Streams undergo several adverse changes whose cumulative effects seriously degrade favorable habitat conditions (Bianchi, 1966). Streamside vegetation is destroyed or reduced in the amount of cover, and composition changes to less desirable species. Grazing of the banks eliminates vegetation overhang that provides bank stability and cover, causes increased bank erosion and stream temperature, and decreased shelter needed to maintain productive fish populations (Platts and Rountree, 1972). Trailing or movement along the bank's edge by livestock weakens, and in some cases, collapses undercut banks causing stream sedimentation and elimination of shelter. Unmanaged grazing results in significantly more lateral channel migration during floods (Marcuson, 1968 and 1971). Trampling in the stream breaks down favorable pool-riffle relationships; in both streams and reservoirs the water becomes clouded and muddy by fine sediments, all of which affect aquatic food organisms and spawning beds of some fish species.

Effects of the intensive management proposal in guiding ecological vegetative succession for the benefit of terrestrial wildlife has been previously discussed. In essence, management can be designed to provide an optimum vegetative composition for the benefit of wildlife inhabiting the management area.

Effects of intensive management on the aquatic habitat poses a different set of problems. In a four-pasture rest rotation intensive management system for example, at least one pasture would be rested for an entire year but the remaining pastures would be grazed at some time during the year. Although streambank and shoreline vegetation would be rested for at least one year in one pasture during which natural ecological forces would operate, the vegetation would likely be grazed in subsequent years and in other pastures as the rotation cycle was completed. Animals would wade into and "muddy" the waters, disturbing pool-riffle relationships in streams. Possible mitigation of these effects under intensive management will be discussed later.

It is known that reservoirs in intensively managed allotments compared to those in unmanaged allotments produced considerable more shoreline and submergent vegetation resulting in a 350 percent increase in number of broods of migratory water fowl (Gjersing, 1971). Also broods from reservoirs in intensively managed areas were larger than those from unmanaged areas. At least part of this success is due to the more luxuriant vegetation growing immediately adjacent to the reservoirs (within 100 yards) resulting from intensive management and used for

nesting habitat. The "key" here is that management be designed in such a way that this habitat not be grazed too short (leaving a residual for nesting) and that grazing animals not be allowed into the pasture until the broods are hatched and reach the water to prevent trampling of nests and eggs near the water (Gjersing, 1971).

Trampling

Trampling by animals compacts most soils containing high proportions of silt and clay. Sandy soils are not compacted to the same degree. Where humus is minimal, soil compaction may persist for longer periods of time. In unmanaged allotments, animals move about freely so that compaction may occur throughout the area but especially in areas of concentration. Where temperature fluctuation (freezing and thawing) is commonplace, the soil may regain its original tilth if the animals are removed. Compacted soil inhibits infiltration of rainfall which, while making less moisture available for vegetation, also increases water runoff and starts the erosion process discussed earlier.

The intensive management program is beneficial to soil in several respects. Significantly more biomass will be produced which, when not grazed, will fall to the ground as litter and eventually be incorporated in the soil as humus. With greater soil humus, impacts of trampling are not so severe. Also, pastures which are rested from

grazing provides the opportunity to "rest" the soil from trampling allowing the natural forces of temperature fluctuation primarily to restore the previously trampled soil to a natural state.

One of the grazing treatments in an intensive management system is to allow one pasture (or more) to rest until seed ripe on the desirable species; then to graze the pasture, using the animals to shatter and scatter seed and, by the action of their hooves, to scarify the soil surface forming little water pockets and planting the seed. Then the pasture is rested again to allow seedlings to become established.

Water

Certain aspects of watershed hydrology, soil moisture, and erosion have been previously discussed from the standpoint of the importance of intensive management to provide good protective cover of healthy vegetation, root systems, and litter. Other aspects of water yield are impacted by grazing.

Unmanaged and indiscriminate grazing in the past, and cessation of natural fires, has resulted in vegetation composition changes to deep-rooted brush and woody species. These have a greater demand for water consumption and as a result several historically known springs and seeps have dried up. In addition, lack of groundcover resulting from poor management permitted water runoff to fill earthen tanks and reservoirs.

With intensive management and changes in vegetation composition and cover to more nearly approach the ecological potential, several of these previously dry springs have since begun to flow water again because of better infiltration and percolation of water. In some cases, elimination of brush and woody vegetation was aided by mechanical or chemical means and was not accomplished solely by intensive management. Nevertheless, proper management is necessary to maintain the improved vegetative cover. By the same token, increased herbaceous ground cover has reduced or eliminated runoff in some cases and some ponds and reservoirs have gone dry. It appears, then, that intensive management will restore water flow in some springs and seeps but location of reservoirs and ponds will have to be more carefully considered.

Pollution

Livestock wading into streams and reservoirs resulting in pollution by suspended sediments was previously discussed. In addition, animals may excrete liquid and solid wastes in the water, adding bacteria and nitrates, contributing to eutrophication, algae blooms, and oxygen depletion.

Without the intensive management program, cattle concentrate near water sources, in shaded areas, accessible areas, along fences, etc. These habits concentrate animal wastes resulting in offensive odors, populations of flies and other insects, and unsightly landscapes.

With intensive livestock management, they may still have access to water sources and will, therefore, continue to pollute water with suspended sediments and animal wastes. But with a rotation sequence among pastures, this will not be occurring in all pastures and all water all the time.

Also, rotation of grazing among pastures forces better distribution of the animals and concentrations of wastes are not so likely to occur. Intensive management makes it possible for the animals to deposit wastes over several acres of pasture land where the natural assimilative capacity of the soil can absorb and degrade the wastes without adverse environmental effects.

Aesthetic Values

A landscape cover of diversified vegetation of grasses, forbs, shrubs, and trees is more pleasing than one of gullies, bare soils, and a monoculture or sparcity of vegetation. To many individuals, a herd of livestock grazing on lush healthy vegetation provides a scene of pastoral peacefulness and is a pleasant experience.

Facilities needed to implement the intensive management program, such as fence construction and water development, can create adverse aesthetic reaction as well as physically destroying resource values. Further discussion of these impacts is presented in Section IV, Mitigation.

Recreation

According to Clawson (1971) the Bureau of Land Management is a relative newcomer among federal agencies in providing outdoor recreation opportunities on an organized basis. He points out that in 1967 there were 49 million visits for recreation on BLM lands. The number of visits are increasing at a tremendous rate as pointed out earlier in this section. The value of these recreational visits to local communities is significant in terms of food, lodging, supplies, etc. Most of the BLM lands are not developed for intensive recreational uses. Instead much of the demand for these areas is by people who seek the charm of areas that are undeveloped or only modestly developed. Scattered throughout the Bureau's lands are streams, lakes, springs and man-made lakes which are ideal sites for fishing, camping, exploring and hiking, visiting historic and archeologic sites and general enjoyment of the outdoors. Hunting is permitted by state law and is one of the most popular activities occurring on BLM lands. Much of the Bureau's area contains many sites of historical interest such as old mine ruins, ghost towns, deserted military posts, areas for amateur geologists and anthropological sites such as cave dwellings and petroglyphs. In some areas, old immigration routes are marked or may be found by use of maps.

There are still old barrel hoops, wagon wheels, and other indications of the passage of the pioneers toward the West. These attractions, plus the charm of the large expanses of open country and a chance to

experience the peace and solitude of limited encounters with other people attract visitors from throughout the country.

Outdoor recreation activities on land administered by the Bureau generates income through the expenditures made by the recreationists. They purchase fuel for their vehicles, food, beverages and other supplies, and utilize motels and eating establishments. In many areas, the economy of local communities is highly dependent upon the income generated by recreation expenditures.

In most cases, it appears that properly managed livestock grazing and most forms of recreation which take place on BLM lands are compatible. There are some cases, however, where livestock grazing may interfere with recreation and vice versa. The fences needed for intensive livestock management may also restrict recreational use of areas. The use of cattleguards and gates along access roads eliminates most of these problems. But, many times uninformed recreationists are unsure of the ownership of lands beyond gates and may be hesitant to enter through gates. Conversely, recreationists often leave gates open which causes problems for ranchers owning the livestock and creates friction between the recreationists and the ranchers.

Due to limited access to water sources, recreationists often use areas as campsites where stockwatering facilities exist. As a result, livestock and wildlife are often kept from using these facilities and

causes friction between livestock operators and the recreationist. Littering and vandalism by some recreationists also present a problem for livestock operators. Holes shot in steel storage tanks and trash dumped here and there are distinct problems to the livestock operator.

The sight of livestock for some recreationists spoils the enjoyment of a recreation outing. During hunting seasons for big game, the hunter often dislikes seeing domestic grazing animals. Although these problems are hard to overcome if areas are to be used for grazing, they can be minimized by choice of seasons of use for livestock. Additionally, livestock may be somewhat restricted from particular fragile or scenic areas where recreationists may be found to frequent.

The problems discussed concerning overgrazing of forests, watershed and wildlife apply to recreational uses of these areas as well. In general, what is good for these resources is good for recreation as well.

Another area where livestock grazing and recreation may be somewhat incompatible is the use of off-road recreation vehicles (ORV). The use of these vehicles on roadless areas of the public lands often destroys fragile vegetation and makes ruts in fragile soils which allow for erosion to take place. Additionally, some ORV users inten-

ionally or unintentionally chase livestock and wild game causing them physical harm. Additionally, some fences are cut because they restrict the free movement of the ORV user. Because of the incompatible nature of the ORV and livestock grazing, the Bureau is attempting to set aside areas for ORV's to operate and restrict them elsewhere.

Proper intensive grazing management, plus some thought to ways to eliminate or reduce possible conflicts between the ranchers and the recreationists should enhance both uses. In times past, before the advent of intensive grazing management, it seemed that livestock grazing was detrimental to recreation. But, today, with intensive grazing management, the increasing numbers of recreationists pose more problems to livestock grazing. Because of the dependence of many local communities upon the income generated by both activities, everything possible should be done to make the two activities as compatible as possible.

Mining

Grazing and mineral production are generally incompatible. This is because mineral production usually involves destruction of site vegetation and thus eliminates grazing. Additionally, mineral production usually involves large equipment which pose physical dangers

for the livestock. But, because of the limited sizes of mineral production sites and the high values derived from them, and because of the laws regarding minerals, grazing usually must allow mineral production to take place.

Predator Control

Control of animals committing depradations on livestock grazing on national resource lands is an authorized program under policy guidelines adopted by the Secretary of the Department of the Interior.

With the intensive management program, grazing animals will be confined into one or more pastures at any given time and, hence, can be better kept under surveillance for possible predator attack. Without management, the animals are scattered throughout the entire allotment and not so easily observed. If there is a known predator problem in a certain area during a particular season, the intensive management system can be designed to rotate grazing use away from this problem area during the time of danger.

Drought

Effects of drought on plants weakened by continuous, unmanaged grazing have been previously discussed. The weakened, less extensive root system caused by improper management is much more susceptible to drought. With intensive management, however, resting of the plants from grazing will restore vigor resulting in a sustained yield of maximum vegetation production. During periods of extended drought, the rested pastures serve as a "standing haystack" and may be grazed

to prevent starvation of the animals or the economic hardship imposed by buying hay or shipping animals to market.

Trespass

During past unmanaged grazing and depletion of the vegetative resource, the temptation may have been prevalent to permit animals to graze across the fence into another allotment.

With intensive management and the subsequent restoration of vegetative production, ample feed resources should be availalbe in one's own allotment so that the temptation to trespass into "greener pastures" no longer prevails.

ALPHABETICAL LISTING OF REFERENCES USED FOR ENVIRONMENTAL IMPACTS

Bianchi, Donald R. and Don Gunderson, 1966. Rock Creek Floodplain Study, South Central Montana Fisheries Study, Montana Fish and Game Department Job Completion Report, F 20-R-9, Job No. II B.

Clawson, Marion, 1971. The Bureau of Land Management, Praeger Publishers, New York.

Clawson, Marion, 1961. "Potential Demand for Nonfarm Products and Services Provided by Agricultural Lands" in Dynamics of Land Use - Needed Adjustment. Iowa State University Press, Ames, Iowa.

Clawson, Marion and Burnell Held, 1957. The Federal Lands: Their Use and Management. Published for Resource for the Future, Inc., by John Hopkins Press, Baltimore.

Gjersing, Frank M., 1971. A Study of Waterfowl Production on Two Rest-Rotation Grazing Units in Northcentral Montana. Unpublished Thesis, Montana State University, Bozeman.

Marcuson, Pat, 1968. Rock Creek Floodplain Study, South Central Montana Fishery Study, Montana Fish and Game Department Job Completion Report, F 20-R-12, Job No. II, 4 pp.

Marcuson, Pat., 1971. Rock Creek Floodplain Study, South Central Montana Fishery Study, Montana Fish and Game Department Job Completion Report F 20-R-14, Job No. II-a, 4 pp.

Platts, William S. and Charles Rountree, December 1972. Bear Valley Creek, Idaho. Aquatic Environment and Fisheries Study. Unpublished report. Intermountain Region, Forest Service, U. S. Department of Agriculture, 53 pp.

Roberts, N. Keith, "Managing Private Lands in Relation to the Changing Uses of Public Lands" in Land and Water Use, pp. 115-131, edited by Wynne Thorne, Publication No. 73 of the American Association for the Advancement of Science, Washington, D. C., 1963.

5. Mitigating Measures

IV. Mitigating Measures Included in the Proposed Action

The intensive management proposal is, in itself, a measure to mitigate the effects of improper management on vegetation and soil resources by working with, directing, and controlling natural ecological processes.

Properly planned and adequately supervised livestock grazing programs will correct and reverse many of the adverse impacts that have accrued to the national resource lands through inadequate management during the last century. However, intensive management requires the installation of some facilities to provide for control and manipulation of the livestock and to prevent damage to the environment. These facilities in themselves may cause some disturbance of the environment as has been noted earlier.

Fences are used only where necessary in the development of grazing management systems. Natural barriers are utilized in lieu of fences where possible. Passes, gaps, ramps, or let-down fences are provided as needed to permit migration of wildlife. Cattleguards are placed at intersections of commonly traveled roads, and gates are provided where fences cross trails and lesser-traveled roads so that access is available to recreationists and the general public. Fences are provided as needed to protect archeological, historical, and other high public value resources. All fences and appurtenances are designed, located, and constructed so as to blend in

with the landscape as much as possible. The practice of clearing fence lines with a bulldozer will not be followed and fences will not be constructed in a straight line.

High quality aquatic habitat, fishery streams, and reservoirs can be fenced from access by livestock where the intensive management pasture rotation program does not provide adequate protection.

Water developments are located to provide wildlife needs and more even distribution of livestock use. Proper management and rotation of livestock decreases soil disturbance, provides for greater wildlife use, avoids concentrated animal wastes, and preserves esthetic values. Water source areas are fenced and the water piped to tanks and troughs outside the fenced area to prevent degradation of the water source and preserve water quality. Water for wildlife, and bird ramps in tanks and troughs to prevent loss of wildlife, are provided with the water developments. Where potable water is available and a public need exists, water is made available for human use. Water developments and facilities are designed, located, and constructed so as to be compatible with the local surroundings. Cuts, fills, and embankments and other construction disturbances will be shaped, seeded, and stabilized.

Land treatments are kept to an absolute minimum, with major emphasis on intensive management, but those that are proposed will be subjected to analysis of their environmental impacts on all resource with the landscape as much as possible. The practice of clearing fence lines with a bulldozer will not be followed and fences will not be constructed in a straight line.

High quality aquatic habitat, fishery streams, and reservoirs are to be fenced from access by livestock where the intensive management practices selected will not provide adequate protection.

Water developments are located to provide wildlife needs and more even distribution of livestock use. Proper construction and siting of livestock developments will, incidentally, provide for greater wildlife use, through concentrated regular supply, and provide adequate escape. Water would be free of the trough and the water piped to reach and readily provide the proper flow to maintain downstream of existing points and riparian water quality. Water for wildlife and wild horses is never used directly to provide some of wildlife are provided with the water development. Where potable water is available and a public land source, water is made available for human use. Water developments and facilities are designed, located, and constructed so as to be compatible with the local surroundings. Cuts, fills, and embankments and other construction disturbances will be shaped, graded, and revegetated.

Land treatments are kept to an absolute minimum, with major emphasis on intensive management, but those that are proposed will be subjected to analysis of their environmental impacts as all resource values involved. Projects are designed and developed in a manner causing least damage to the resources. Such projects could include but are not limited to herbicide treatments, plowing, seeding, chaining, controlled burning, contour furrowing, pitting, root plowing, etc.

All artificial treatments will be used only where natural recovery is not possible. Such treatments, if necessary, will be designed to leave islands and strips of natural vegetation with irregular edges conforming to existing landscapes. Straight lines and large blocks of treated areas will be avoided.

Other considerations as needed are made during the design and operation of the grazing system. Major emphasis is directed toward creating and maintaining a vegetative mantle over the soil that will effectively reduce soil erosion and provide for site and watershed improvement. Close and continuing monitoring of the area of land and ongoing uses is a necessity.

6. Adverse Effects

V. Adverse Effects That Cannot Be Avoided

In the two previous sections of this statement numerous aspects associated with intensive management of livestock grazing have been discussed in the light of their effects upon the environment. It is recognized that several activities needed to support properly managed livestock grazing violate in varying degrees a primeval virgin Western rangeland concept. However, with consideration, judgment and concern for all resource values, the adverse impact of most of the facilities such as fences, water developments and land treatment projects can be either avoided or reduced to minimal impact. Fences and water developments can be removed if the need arises in the future; therefore these impacts are not irreversible.

There are, however, some adverse effects that cannot be avoided: (1) removal of energy and minerals from the site in the form of animal products which prevents, to a minor degree, natural cycling; (2) water pollution will occur where animals have access to streams and reservoirs; and (3) livestock concentration areas.

7. Short-term uses vs.
Long-term productivity

VI. The Relationship Between Local Short-term Uses of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

All resource management decisions resulting from the Bureau Planning System require that the relationship between local short-term uses and maintenance and enhancement of long-term productivity be carefully considered. Accordingly, under existing legislative direction, the resource manager is required to blend management efforts to provide forage for livestock and concurrently improve and maintain the range ecosystem for a multitude of other resource values.

Good vegetative cover is the basis for many uses of the range resource. It provides feed and cover for wildlife, protective cover for watersheds, forage for livestock and, to some extent, aesthetic values and scenic landscapes are dependent upon the quality and quantity of vegetation. Directly or indirectly, vegetation is the foundation for all renewable resource values and ecological succession can be directed by the way it is managed.

The major objective of intensive management grazing systems in management of national resource lands is to maintain or improve range condition. Good range condition is the key to assuring optimum use of renewable resources and sustained yields of resource values. Vegetation is a renewable resource which serves a variety of uses.

Harvesting of vegetation by grazing animals in a properly designed grazing system is one of the beneficial uses and an important force in the evolutionary development of rangeland ecosystems. The several million cattle and sheep that graze in the western United States represent an opportunity for man to beneficially influence the environment and simultaneously contribute to the stability of the livestock industry dependent upon national resource lands.

Allotment management plans are structured to use livestock as a management "tool" to manipulate vegetation cover and composition. All resource values are given equal consideration consistent with public demand and resource capabilities. In many instances, increased forage production for livestock use may not be the primary objective. For example, some grazing systems are designed to improve browse species for critical big-game winter range. These systems are designed for livestock to utilize grass in the spring but are removed before they make significant use of the browse. Over time, improved range condition will provide increased forage production for livestock use and improved condition for watershed protection and wildlife habitat.

The short-term use of national resource lands by domestic livestock is managed to provide stabilization to the livestock industry while restoring ecosystems to their natural productive state.

Management of grazing is guided and controlled to aid in the biological processes for long-term environmental enhancement and sustained resource productivity. The key, however, to the maintenance and enhancement of long-term productivity while optimizing short-term use through intensive livestock grazing management depends upon the Bureau's capability in terms of adequate funding and manpower to implement this proposal.

8. Commitment of Resources

VII. Commitment of Resources

Proper management of livestock and the resultant utilization of forage will not commit the resources to irretrievable or irreversible loss. Vegetation is a renewable resource and when livestock are managed in properly designed grazing systems, resource productivity is enhanced by improved vigor and composition of the desirable native species. Grazing management is flexible, viable, and dynamic. As dictated by future demands, grazing use can be modified as necessary to provide for changes in the vegetative component as desired, to meet the needs for watershed, wildlife, etc.

In most instances range improvements, such as fences and water developments, installed to implement grazing systems can be salvaged or rehabilitated if desired. Secondary access roads may be rehabilitated or retained as management requires. Seeded monocultures do not present a problem. They can be kept to a minimum and must be managed with livestock similar to natural vegetation in order to protect the investment.

9. Alternatives

VIII. Alternatives

Alternatives to an intensive livestock grazing management program are (1) custodial supervision, (2) removal of all domestic livestock from national resource lands, (3) moratorium on livestock grazing until funds are available to initiate and fully implement an intensive management program, and (4) disposal of all national resource lands.

1. Custodial Supervision

Sufficient personnel would be retained to issue long-term grazing permits, collect fees, and complete necessary administrative functions. Management of the range ecosystem would rest with the licensee, whose interest may well be maximum livestock production at the lowest possible per unit cost with little regard for other values. Costs and maintenance of any needed improvements or facilities such as land treatments, fences, and water developments would be borne by the licensee.

Under a program of this type, administrative costs to the public would be at a minimum, but public benefits would be at a minimum as well. Except for predatory animals, wildlife seldom interfere with livestock, particularly where private economic gains are the primary goal. Conflicts often arise where there is competition for food, water, or cover. Activities of recreationists, particularly hunters, often conflict with those of livestock and

livestock operators. Disturbing livestock, leaving gates open, littering, traveling on muddy roads, vandalism, and theft create adverse rancher-recreationist relationships.

With only custodial supervision, persistent season-long or year-long grazing of livestock would occur on many allotments. This unmanaged use does not consider the physiological needs of the forage plants and would result in range deterioration and eventual reduction in the numbers of livestock that could be grazed. Abuse of the range ecosystem creates an imbalance which results in future losses of resources affecting watershed, wildlife, recreation and aesthetics.

Custodial supervision would neither stabilize livestock use nor the sum total of resources in the range ecosystem. It definitely would not maximize production in any area of the ecosystem and, in fact, would result in environmental degradation. Past history is the best example of the impracticality of this alternative.

2. Removal of All Domestic Livestock.

Removal of all domestic animals from the national resource lands has a strong appeal to some segments of the public, because it envisions a return to "natural" or "native" conditions which existed prior to settlement and exists, to a certain extent, in some National Parks today. This attitude stems from the rationale that the national resource lands belong to "all of the people"

and should be reserved for the use of all individuals rather than exploited for the economic benefit of a few.

Elimination of livestock grazing would no doubt enhance the visual type of recreational activity, although the peaceful pastoral scene of livestock grazing on well-managed rangeland is esthetically pleasing to many people.

With removal of livestock all vegetation would be left in place to be recycled within the range ecosystem. Nutrients would be returned to the soil instead of converted to animal products and removed from the site. Soil compaction resulting from animal trampling would be eliminated. Generally soil protection could be expected to improve since all vegetative material would remain on the site except for that utilized by wildlife. With accumulation of litter, compacting effect of raindrop impact would be reduced, infiltration of precipitation would be increased, erosion-causing runoff would be reduced, and eventually many watersheds would become stabilized, resulting in stabilized stream flow and improved water quality in streams and lakes.

The foregoing expectations presume control of wildlife populations as well, particularly large herbivores and wild horses. It is fully as important to limit wildlife numbers as it is to limit livestock use on rangelands, perhaps more so because wildlife must sustain themselves year-round on many of the public lands

and they cannot be managed except by control of numbers. Uncontrolled, large herbivores will increase to the point where the imbalance in the ecosystem is so severe that forage resources are destroyed or irreparably damaged before starvation and disease begin to take their toll on animal populations. The experience with the Kaibab deer herd in Arizona during the 1920's is a notable example (Leopold, 1947). Also, uncontrolled wild horses can cause an even greater imbalance in the ecosystem because they have few natural enemies.

Elimination of grazing on land administered by the Bureau of Land Management would probably result in several economic effects. These would be most pronounced in the 11 Western States, but some would also be felt nationwide.

The following list is not all inclusive, but does try to include the most obvious:

1. Cattle and sheep prices and prices of their products would increase.
2. Forage prices would increase.
3. Average costs of producing livestock would likely increase for ranchers previously using BLM range.
4. Ranch incomes should decrease.
5. Incomes of State and local economies would decrease.
6. Ranch operations highly dependent on national resource lands for grazing would be forced out of business.

The first five items listed are all interrelated to some degree. To begin with, cattle and sheep prices would probably fall in the short run as a result of elimination of public land grazing privileges because ranchers would have to reduce their herd size and millions of cattle and sheep would go to market. But in the long run, prices of cattle and sheep marketed would increase because of a combination of fewer livestock numbers and increased price of forage and other feeds due to the loss of public grazing.

Ranchers' average costs per animal produced would likely increase as a result of diseconomies of scale of the livestock ranch. In a study by Gray, Stubblefield and Roberts (1965) regarding the economics of range improvement practices, they indicate the expected costs and returns for several representative ranches of small, medium and large size in New Mexico, Arizona, and Utah. In general, they found that the medium and large-sized ranches had lesser costs per animal unit and larger incomes and percentage returns to investment than did the small-sized ranches.

Similar results were found in a study conducted by the Economic Research Service (1965) concerning the impacts of changes in grazing fees on income of western livestock ranches. They found that cash and noncash costs per animal unit on 69 representative cattle ranches ranged from $60.50 per animal unit on ranches with less than 151 animal units to $32.50 for ranches with more than 651 animal units.

Since the majority of western ranchers are already comparatively small they would be more likely to face diseconomies of scale due to a loss of public grazing and the consequent decrease in herd size would result in losses of net ranch income. The implications are then, since public grazing is an integral part of a large percentage of livestock ranches in the West, the reduction or elimination of grazing on Federal lands would force the ranches into a smaller scale of operation, thus raising costs and reducing incomes. The subsequent impact on employment and the economics of dependent communities would be pronounced, further hastening the rural exodus. Thus the social and economic impact on local communities would mean the difference of survival or bankruptcy to many dependent livestock operations. Furthermore, it is culturally unacceptable to many people to leave unharvested a renewable resource that could be used in the production of red meat, an item in great demand for most people.

Perhaps the most undesirable aspect of livestock removal is that it eliminates a natural component, a readily available and easily manageable "tool" which can be used to manipulate and complement natural ecological processes and mechanisms to achieve desired results.

The many long-standing fenced exclosures throughout the West bear evidence that the exclusion of grazing does not produce optimum

range condition. After 20 years or more of livestock exclusion, many of these have reached a point of vegetative stagnation which is well below optimum for watershed protection and forage production. On the other hand, the grazing process can reverse the trend of stagnation brought about by nonuse.

Through intensive management of livestock grazing, key vegetative species essential for wildlife herbivores on many ranges can be sustained. Removal of livestock would require an artificial harvest or clipping of vegetative browse species to accomplish the same results obtained by seasonal grazing of livestock to improve grazing conditions for wildlife. Under this alternative, if maintenance of wildlife is an objective of the land use plan, manpower and funds must be provided to artificially maintain the vegetative resource to support wildlife.

Removal of grazing animals from certain biomes or frail areas within biomes is a realistic approach to solving resource problems which cannot be mitigated by intensive management. Such decisions can be accommodated within the authority of existing legislation and regulations. Many of these situations exist and removal of livestock from these lands would not significantly impact rural economies although individual ranchers would be economically impacted. Delicate biomes such as the Hot Desert and Tundra would be affected to the greatest extent.

Elimination of livestock from all national resource lands would require amendment of legislation that currently provides for livestock grazing on the national resource lands.

The Taylor Grazing Act encompasses in its charter, "stabilization of the livestock industry dependent on the public lands." This clearly shows that the Bureau of Land Management is not in the position to eliminate livestock grazing on these lands except where it is clearly substantiated by resource data that removal is essential to sound resource management. Such actions would have to be sustained through administrative procedures review and any subsequent court actions which would be initiated.

3. Moratorium on Livestock Grazing.

Until funds are available to initiate intensive livestock management on all national resource lands, placing a moratorium on the issuance of grazing licenses and permits would result in immediate short-term benefits similar to those discussed under livestock removal. A degree of vegetative improvement could be expected during the period of nonuse on some areas and the deterioration of range conditions would be greatly reduced. The range ecosystem would be in a favorable position for recovery at such time that intensive grazing management is applied.

The period of moratorium would prove a severe economic strain for many individual ranchers who are highly dependent on the public

social and economic impact would be traumatic to dependent ranching operations and communities.

Certainly strong objections to a moratorium would be encountered, but likely there would also be strong support for this action. Such a move might stimulate agitation for and hasten funding for intensive grazing management. Again, this move would require modification of laws governing issuance of grazing licenses on the natural resource lands.

4. Disposal of the National Resource Lands

Disposal of the national resource lands was a significant part of the historic growth of the Nation. As a matter of policy, sale and grants of public lands were the primary functions of the General Land Office in the development of the West. Even today, disposal of public lands to the private sector is advocated by many individuals. Some disposal, through sales, exchanges, etc., is still proceeding.

By disposing of national resource lands, costs of administration would be eliminated, but so would public values. The purchaser would be free to use his land as he saw fit and as economic pressures dictated. It is doubtful disposal of these lands would result in cessation of livestock grazing and the adverse effects of improper livestock grazing.

complying operations and contracting.

Similarly, private objectives of a corporation would be accomplished, for private firms would give it strong support for this activity [illegible] their activity and would provide [illegible] growth [illegible]. Lastly, this [illegible] would require [illegible] than [illegible] of greater [illegible] on the national resource lands.

c. Disposal of the National Resource Lands

Disposal of the national resource lands was a significant part of the historic growth of the Nation. As a matter of policy, sale and grants of public lands served to place the lands of the [illegible] land system in the development of the West. [illegible] disposal of public lands to the private sector [illegible] direct disposals, through sales, exchanges, etc., is still [illegible].

By disposing of national resource lands, costs of administration would be eliminated, but so would public values. The permanent [illegible] of these to the Nation [illegible] not be accurately measured [illegible]. [illegible] disposal of these lands would result in [illegible] of livestock grazing and the [illegible] effects on [illegible]

A related proposal would be disposal of the national resource lands to the States. Policy of the Western States to date is generally to lease lands to the highest bidder with little attention for the degree of use made of them. This is because of political and economic realities. As a result, a lessee usually assumes a strong proprietary attitude that minimizes public benefits. It must be assumed that State ownership of these lands would result in significant acreages being sold to private citizens, groups, or corporations.

Alphabetical Listing of References for the Discussion of Alternatives

Economic Research Service, U. S. Department of Agriculture. 1965 Effects of Changes in.....Grazing Fees and Permitted Use of Public Rangelands on Incomes of Western Livestock Ranches, ERS 248, Washington, D. C.

Gray, James R., Thomas M. Stubblefield and N. Keith Roberts, 1965. Economic Aspects of Range Improvements in the Southwest, A Western Regional Publication, New Mexico Agricultural Experiment Station Bulletin 498.

Hormay, August L. 1970. Principles of Rest-Rotation Grazing and Multiple-Use Land Management (TT-4)(2200). U. S. Bureau of Land Management and U. S. Forest Service

Leopold, Aldo et al. 1947. A Survey of Over-Populated Deer Ranges in the United States. Jour. of Wildlife Management, Vol. II, No. 2: 162-177.

10. Consultation or
Coordination

IX. Consultation and Coordination in the Development of the Proposal and the Preparation of the Draft Statement.

During the formulation of the programmatic statement, consultations were held with representatives of user groups, academic community, professional societies, conservation organizations, and Federal and State land management agencies. These included such organizations as: National Wildlife Federation, National Resources Defense Council, Sierra Club, American National Cattlemen's Association, National Wool Growers, Colorado State University, Utah State University, Society for Range Management, U. S. Forest Service, and Idaho Department of Public Lands.

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